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Shows the under surface of the brace and the outer flange. B—The calcaneo-cuboid articulation. C—The extremity of the fifth metatarsal bone.

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The Journal of Orthopædic Surgery

NOTICE TO READERS

The answers received from members of the American Orthopedic Association and other readers of the JOURNAL OF ORTHOPÆDIC SURGERY to the notice inserted in the August number of the Journal in reference to a change in form from a monthly to a quarterly publication have been so overwhelmingly in favor of the latter that the Executive and Editorial Committees of the Association have decided to make the change beginning with the January issue.

At that time the name will also be changed from THE JOURNAL OF ORTHOPÆDIC SURGERY to THE JOURNAL OF BONE AND JOINT SURGERY —THE MECHANICS OF FUNCTION.

In issuing the JOURNAL every three months it will be possible to present to the readers fully as much, or even more, reading matter than under the existing arrangement, and it is hoped that the JOURNAL may be made more valuable and interesting.

EDITORIAL DEPARTMENT

FOREWORD FOR THE YEAR 1922.

BEGINNING with the succeeding issue, the JOURNAL will be changed to a quarterly publication. This decision was arrived at by the Executive and Editorial Committees after deliberate consideration, and after

having received a large number of opinions from subscribers, which were almost unanimously in favor of this change. It is believed that, in this form, the material can be so presented that it will be of much greater value to the readers of the JOURNAL, and we are asking the coöperation of all to aid in making this change a success.

Also, with this issue, the JOURNAL will appear under a new name. The title of "THE JOURNAL OF ORTHOPAEDIC SURGERY" will be replaced by "THE JOURNAL OF BONE AND JOINT SURGERY—THE MECHANICS OF FUNCTION." It may be said, and truly so, that this mantle will not cover all of the contents which will be placed under its shelter, but this would be quite as true of any title which might be selected, and certainly is it so of the term "Orthopædic Surgery." The Committee has decided upon this name after careful consideration, and believes that it will best designate, in general, the department of surgery which will be represented by the class of papers and subjects which come naturally under its publications.

The question will naturally arise as to the reason and the advisability for the change in name, particularly to one that is not perfect. It is in accordance with a broader understanding of what specialties actually are, and of the position that they should occupy in relation to the art of medicine and surgery.

The scope of a specialty in surgery, with its many ramifications and inter-relations with allied branches, is not a problem which can be settled by an arbitrary division of work. As orthopaedic surgeons, we can make no definite boundaries of inclusion or exclusion, and it is fortunate that such is the case. The position of orthopaedic surgery, and the work of orthopaedic surgeons, varies so greatly geographically, that even for this reason alone, it is impossible to make a division of work which would be equitable to the patient. A specialty demands of its members that they shall be equipped in the different features of treatment which are necessary for the complete care of cases which come under a special grouping,—based on the fundamental knowledge of medicine and surgery, with the added special experience required by any group of cases to which these added features of treatment must be brought.

The demands which orthopaedic surgery must make today are demands upon its members and upon those who interest themselves in developing and perfecting the care of cases which fall under special forms of treatment. The special knowledge necessary is that which pertains to the joint and osseous system, with the allied subjects such as the mechanism of motion; the means and methods necessary

to prevent and to correct deformity; the principle of mechanics as applied to the body (which includes the application of apparatus); the special care in the long post-operative period; and the preservation and early return of function of the locomotive apparatus of the body.

The responsibility for a man's recovery must continue until he is finally replaced in his working status, and the last step in the process of restoration is fully as important as the first step,—which may have been the primary operation. Specialization has brought into prominence the important feature which is beginning to be recognized as an essential in specialization:—namely, the responsibility of the surgeon to so fit himself by knowledge and experience that he may assume the responsibility of all of the phases of treatment during the course of the special cases. This is particularly applicable to that large group of cases which comprise the surgery of bones and joints, etc. Not only must the surgeon who plans to put emphasis on the later treatment—including the various forms of therapy which are directed toward restoration and preservation of function—be qualified for the operative treatment of this case, but it is equally important that a surgeon who performs or takes charge of the preliminary operative treatment be qualified to take the responsibility and direction of all steps in that post-operative period, which may be prolonged, and which may involve mechanical treatment and various forms of restorative therapy. This is important, because it is impossible to divide or transfer the responsibility of control in any stage of the course of treatment without detriment to the patient, and without the loss of that professional interest which is essential to the best results.

As orthopaedic surgeons, our aim is to standardize the requirements of orthopaedic surgery, and to recognize as orthopaedic surgeons those who have qualified to these standards. Our concern is, not with the special grouping of cases, etc., which are to be placed within certain boundaries in the field of surgery or medicine, but rather with the requirements which should be demanded of the men who enter any of these special fields of work—which have more or less of natural boundaries or limits. With special knowledge and experience, cases requiring this equipment will naturally so group themselves as to derive the benefit from it.

By this title of the JOURNAL, we may indicate the subject-matter which should have particular attention by those interested in this

group of cases, and may attempt to furnish material which will be of aid in the equipment of the knowledge of the treatment of such cases. With this change of the name, we trust there will be taken one of the steps to establish specialties in their intimate and true relation to the art of treating by medicine and surgery, the specialty defined rather by the special skill and knowledge possessed by its members, than by an arbitrary division of the field in which they may be placed to work.

Original Communications

OPERATIVE METHODS AND END-RESULTS OF DISABILITIES OF SHOULDER AND ARM.

BY ARTHUR STEINDLER, M.D., F.A.C.S., IOWA CITY, IOWA.

LIMITATION of space and time have made it necessary for the writer to select among the numerous operative methods applied in orthopædic ailments of the upper extremity a smaller group only and to present with all possible briefness the principal points of technic and the operative results. The latter are not, in the strictest sense of the word, results of operative interference as such, but those of a treatment in which operation is an essential, but not necessarily the most important, factor.

The results are measured by function rather than by anatomical realignment. Functional results are not presented by photographic records alone, but also by the physiotherapeutic records of the after-treatment, which express in graphs and curves the progress attained during the course of this treatment.

The writer is aware of the fact that in matters of technic any of the methods described may be substantially improved; it is felt, however, that the present stage of development of orthopædic surgery of the upper extremity, it is the problem of therapeutic principles at large in which criticisms and suggestions will be most helpful.

FIG. 1.

FIG. 2.

FIG. 3.

FIG. 4.

FIGS. 1, 2, and 3.—Manipulative correction.
FIG. 4.—Calcareous deposit.

FIG. 5.

FIG. 6.

FIG. 7.

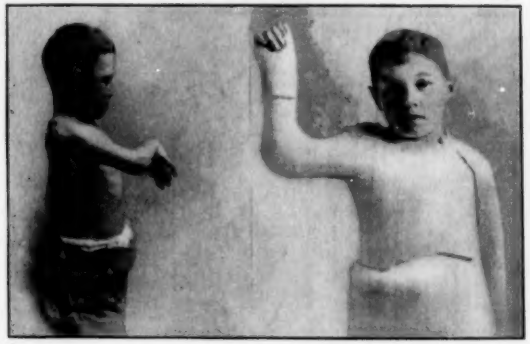


FIG. 8.

FIG. 9.

FIGS. 5 to 9.—Birth palsy. Sever's operation. Reduction of dislocation.

A. Operations for contracture deformities of the shoulder.

1. Manipulative correction of the adduction and inward rotation: The contracture develops in the wake of certain extra articular lesions; following splint fixation, sprains and tears of the adductors, traumatism to the shoulder, in the milder degrees of birth palsy, and especially in subdeltoid bursitis.

Of the latter group 11 cases were treated; 5 cured, 5 improved, 1 not improved.

Manipulative correction is carried out under anæsthesia without any application of force. The position of abduction and outward rotation of the shoulder is secured by a so-called aeroplane splint. After-treatment begins two to three days after manipulation. The degree of abduction is slowly (Dunlop) lessened, *pari passu* with the redevelopment of deltoid function, the angle of the splint being changed in accordance. The average time of treatment in this series of cases was three months. Brickner's open operation was performed in two cases, but no calcareous deposits were found in the supraspinatus tendon (Figures 1, 2, 3, 4).

2. Tenotomies of abductors and inward rotators of the shoulder. Sever's operation. The shoulder contractures developing in obstetrical paralysis not yielding to manipulative stretching form the indication for this method. The technic is generally known. The tendon of the contracted subscapularis muscle is reached from an incision over the inner border of the deltoid and by bluntly proceeding between this muscle and the lateral border of the pectoralis major. In addition to the subscapularis tendon and that of the pectoralis major, the tendons of the short head of the biceps, the coraco-brachialis and of the latissimus dorsi must occasionally be sectioned.

Of eleven cases treated, manipulative correction was applied in five, and open operation in six cases. Of the latter, two belonged to the upper arm type and four to the whole arm type. Posterior dislocation of the head of the humerus, present in two cases, was reduced by manipulation in one case, and by open operation which included the resection of the overhanging acromion in the other.

Results of the operative cases: good in four, fair in one, and undetermined in one case (Figures 5, 6, 7, 8, 9).

B. Arthrodesis of the Shoulder.

This procedure is indicated in the permanently flail shoulder, in deltoid paralysis from anterior poliomyelitis, not remediable by con-

servative treatment; in traumatic ankylosis in malposition, with defect or atrophy of the deltoid muscle.

Technic: Incision is made from the spine of the scapula in an arc which circles the acromions and ends anteriorly over the coracoid process. The skin-fascia flap is prepared upward high enough to expose the edge of the acromion for a distance of 1 inch to 1½ inch. The fibers of the deltoid muscle or its remnants are separated bluntly at lines corresponding to the middle portion, the acromion is incised transversely ¾ to 1 inch from the free edge, cut through with the osteotome, and the flap containing bone and deltoid muscle is turned downward. This brings into full view the lateral aspect of the capsule. The latter is opened by longitudinal incision and the edges of the cut are grasped carefully by forceps and are retracted. The tendon of the long head of the biceps appears, antero-internal to the incision, within the capsule. This exposure of the joint allows complete denudation of the articular ends. For the head of the humerus, this may be facilitated by pushing it through the incision in the capsule out into the wound. Two silver wires are passed through both head and overhanging portion of the acromion. The slack in the capsule is taken up by transverse suturing of the longitudinal slit and the silver wires are then tied over this suture.* Fixation is carried out by a plaster cast with the arm abducted at right angle, inwardly rotated and elbow flexed. The cast remains for two or three months, at the end of which time it is replaced by a platform splint. Then follows the after-treatment, which consists of massage, exercises, and arm-raising drills.

It is unnecessary to wait with the arthrodesis of the shoulder until the fourteenth to eighteenth year, as advocated by Lange. One must consider that the problem of dealing definitely with the flail shoulder often arises in very young children in whom the loss of eight to ten years, spent in waiting, is sure to result in considerable retardation in the development of the whole extremity. Sir Robert Jones advocates arthrodesis at as early an age as six to eight years, and Vacchelli lately reported an operative series with five years as the earliest age.

Right angle abduction was the position of choice. Some authors favor a lesser degree of abduction (Lange). In the writer's series there existed no difficulty in bringing the arm into adduction position; there is, however, a decided tendency to develop scoliosis, and preventive measures must be taken early. Shoulder exercises are combined with corrective gymnastics in the after-treatment.

* Wire sutures have since been substituted by heavy chromic catgut.

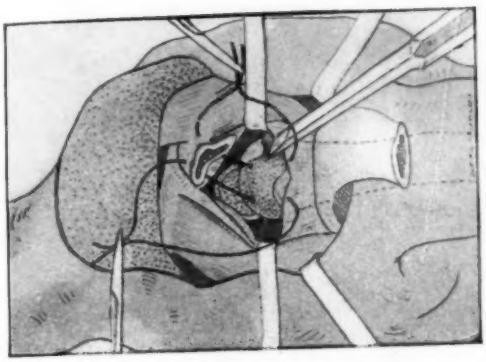


FIG. 12.

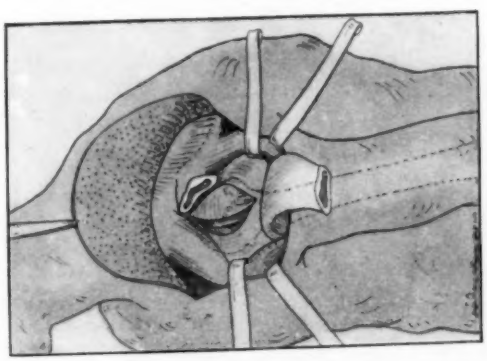


FIG. 11.

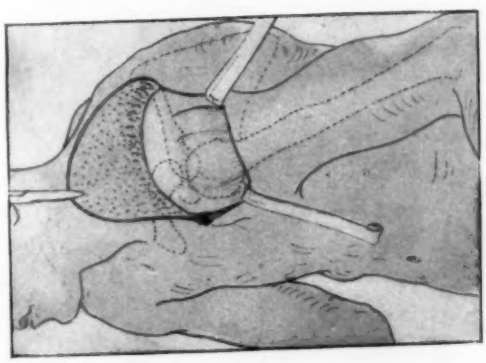


FIG. 10.

FIG. 14.

FIG. 13.

FIG. 15.

FIG. 16.

FIG. 17.

FIGS. 10 to 17.—Arthrodesis of shoulder. Technic and operative results.

Arthrodesis of the shoulder was performed in 19 cases; eight of these cases showed bony, and seven fibrous ankylosis, while in four cases the type of ankylosis was not determined. The operation was done either alone (six cases) or combined with flexor-plasty of the elbow (five cases), with arthrodesis of the wrist (two cases), with tendon transplantation of the wrist (one case), or with both elbow-plasty and arthrodesis of the wrist (four cases).

The age of the patients varied from six to twenty-seven years; the time of observation following operation, from four to fourteen months.

The results (functional) were good in fourteen cases, fair in two cases, and undetermined in three cases. The good results had active abduction ranging from 65 degrees to 120 degrees, the fair cases from 45 degrees to 65 degrees. The curves obtained from the arm-raising drill show percentually the functional gain. The base line (100%) represents the functional value of the other (intact) extremity. (Figures 11, 12, 13, 14, 15, 16, 17.)

C. The Muscle Transposition at the Elbow of Forearm Flexors (Flexor-plasty of Elbow).

The indication for this procedure arises in cases of flail elbow. The method is devised with the object of furnishing some limited flexion power for the flail elbow.

Technic: An incision is made starting three inches above the internal epicondyle of the humerus between the inner border of the brachialis anticus and triceps muscles. It is carried downward to the epicondyle and is continued from this point in an obliquely downward and outward direction over the anterior aspect of the forearm. The ulnar nerve is located and retracted backward, the common origin of the pronator teres, flexor carpi radialis, palmaris longus, and flexor carpi ulnaris muscles is then carefully dissected off the internal condyle. In so doing one must be careful not to injure the nerve supply which reaches these muscles from below. But one and one-half to two inches of the muscle mass may be freed safely. This muscle flap is then lifted up and inserted two inches higher up into a point of the inner intermuscular septum between the brachialis anticus and triceps muscles. A position of acute flexion in the elbow is maintained for not less than two months. After two or three weeks, however, the cast applied at operation may be replaced by a splint having the proper angle so that the after-treatment, consisting in massage and exercises, may begin at this time.

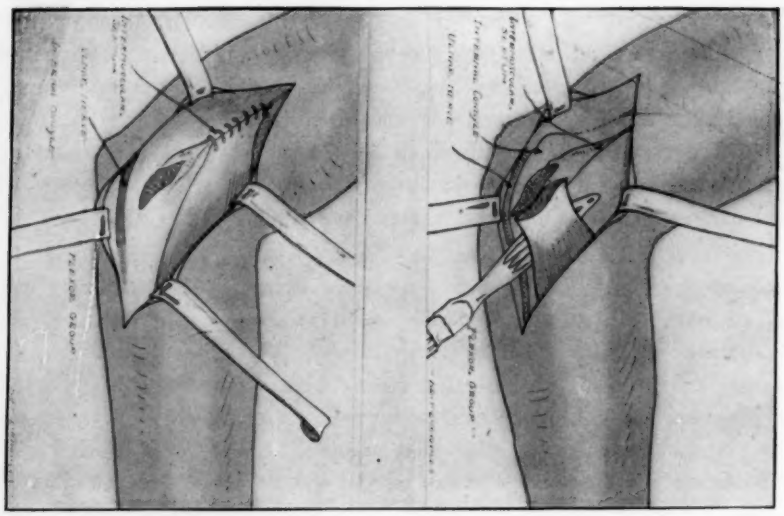


FIG. 18.

FIG. 19.

FIG. 20.

FIGS. 18 to 20.—Flexor plasty of elbow. Technic and operative results.

This method was employed in 17 cases. The ages of the patients ranged from four to twenty-one years; the duration of the paralysis from one to thirteen years. The time of postoperative observation varied from three months to three years.

In six cases this operation was performed alone; in five more it was combined with arthrodesis of the shoulder; in five cases with arthrodesis of the shoulder and wrist, and in one case with arthrodesis of the shoulder and tendon transplantation at the wrist.

The results (functional) were good in nine cases, *i.e.*, active flexion of the elbow in any position was obtained; fair results were obtained in three cases (flexion of the elbow in horizontal position only), and poor results (no flexion) in five cases.

The best results were obtained where this method was combined with arthrodesis of the shoulder. Cause of failure was generally a weakened condition of the flexor muscle used for transposition, and it must be emphasized that a degree of integrity of these muscles is essential for the success of the method (Figures 18, 19, 20).

D. Plasty of the Forearm Muscles. Twenty-eight Cases.

Indications: Pronation and flexion contractures at the elbow and wrist in ischemic myositis, in spastic contractures, in traumatic contractures, in contracted clubhands, etc.

1. Flexor-plasties. Technic: The forearm flexors are dissected from an extended longitudinal incision running along the middle of the volar surface of the forearm. The tendons are isolated and individually lengthened, being incised Z-shape fashion, which permits the split portions to glide along beside each other until the desired length is reached. As much as possible the fascial compartments are reconstructed.

2. Resection and myotomies of the pronators in pronator contraction. The pronator radii teres is reached from an oblique incision starting at the internal epicondyle and following the direction of the pronator teres in its downward and outward course. The pronator quadratus is reached from a mid-volar incision over the lower third of the forearm.

Flexor-plasty was applied alone in 13 cases; combined with pronator resection in two cases; with extensor-plasty of the thumb in two cases; with arthrodesis of the wrist in three cases.

FIG. 21.

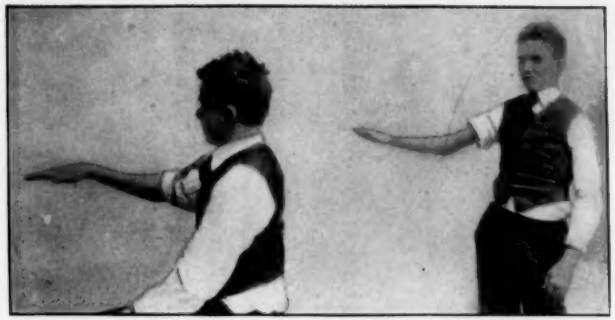


FIG. 22.

FIG. 23.

FIGS. 21 to 23.—Forearm muscle plasties.

FIG. 21.—Ischemic contracture.

FIG. 22.—Traumatic contracture.

FIG. 23.—Spastic contracture. (Pronator resection.)

Pronator resection was performed alone in five cases, combined with flexor-plasty in two cases, and with arthrodesis of the wrist in one case.

The results (functional) were good in 17 cases, fair in nine cases, and poor in two cases (Figures 21, 22, 23).

E. Arthrodesis of the Wrist. Twenty-five Cases.

The indication for this operation was given in cases of flail wrist following infantile paralysis; in drop wrist following peripheral paralysis; in spastic contractures of the wrist and in ankylosis of the wrist in faulty (flexion) position.

Technic: A dorsal incision is made over the wrist between the tendons of the extensor pollicis longus and extensor proprius indicis. The lower end of the radius as well as the scaphoid and os lunatum are exposed. A wedge-shaped piece of bone with dorsal base is resected from the articular surfaces of radius, scaphoid and os lunatum. The position of the wrist is secured in dorsiflexion by sutures passed through drill holes in the bones. A cast is applied reaching from the metacarpo-phalangeal joints to midway between shoulder and elbow. It is allowed to remain for two to three months.

In the 25 cases operated upon the ages ranged between six and twenty-six years. The duration of the condition varied from six months to fifteen years; the time of postoperative observation from two months to eighteen months.

Arthrodesis of the wrist was performed alone in ten cases, combined with arthrodesis of the shoulder in two cases, with tendon transplantation of the fingers in three cases, with forearm muscle plasty in two cases; with arthrodesis of the shoulder and elbow-plasty in three cases; with extensor-plasty of the thumb in two cases; with arthrodesis of the shoulder and flexor-plasty of the thumb in one case; with pronator resection in one case, and with Stoffel's operation in one case.

The results (functional) were good in 14 cases, fair in five cases, poor in four cases and undetermined in two cases (Figures 24, 25, 26).

In paralytic cases, arthrodesis was given preference over tendon transplantation of the wrist, since the cases were few in which there was enough muscle material available to insure both function of the wrist (motion as well as stability) and function of the fingers.

The most favorable results seem to be obtained where different methods were used in combination. This was especially the case in combination of shoulder arthrodesis with flexor transposition at the

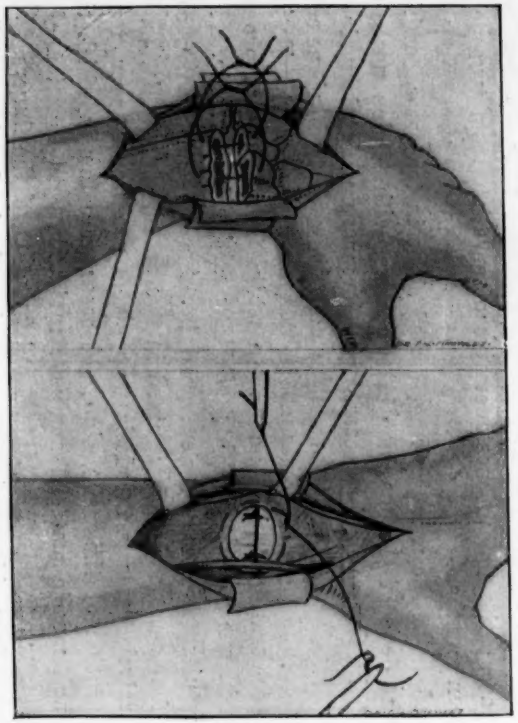


FIG. 24.

FIG. 25.

FIG. 26.

FIGS. 24 to 26.—Arthrodesis of wrist. Technic and operative results.

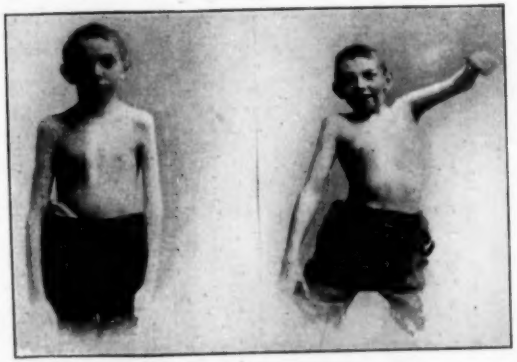


FIG. 27.

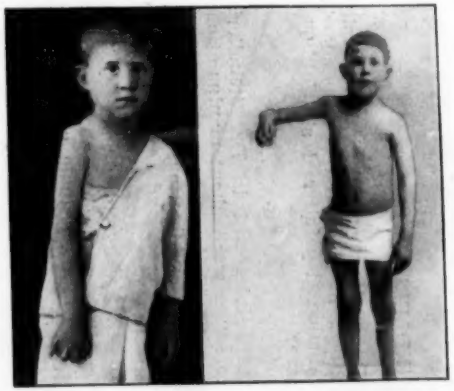


FIG. 28.

FIG. 29.

FIGS. 27 to 29.—Combinations. Arthrodesis shoulder—elbow plasty —arthrodesis wrist.

elbow, the former method procuring the horizontal elevation of the arm in which the elbow action asserted itself to better advantage; it was also true of the combination of these two methods with arthrodesis of the wrist, and of the combination of arthrodesis of the wrist with tendon transplantation of the fingers (Figures 27, 28, 29).

DISCUSSION OF DR. STEINDLER'S PAPER.

DR. OSGOOD: Gentlemen, you have heard this very careful review of significant work. Permit the Chair to say that he has observed Dr. Steindler's work on the ground, and that it is most valuable, hopeful, and skillful. The discussion is to be opened by Dr. J. W. Sever.

DR. JAMES W. SEVER, Boston: I was much interested in Dr. Steindler's paper and his admirable results. I want to say a word about manipulations on the shoulder. I find that it is apparently the fashion now to give up operating on subdeltoid bursae, and that manipulation, fixation, and traction in bed, even if there are deposits in the bursa, are used, and that there have been obtained as good results by that method.

In regard to the stretching operation for definite muscular contraction of the shoulder joint, secondary to obstetrical paralysis, I have not been successful with it because it depends on the fixation of the scapula so much that manipulation, forceful or otherwise, without that fixation, is apparently not very successful. I think that the after-treatment of any of these cases is of paramount importance, particularly in the cases not operated on—not, of course, where there has been an arthrodesis, but where the patient has had a muscle transplantation or a tenotomy. It has been our practice, when there have been cutting operations about the shoulder, to start on exercise as soon as the wound is healed, about the seventh or eighth day. Prolonged fixation without early motion has given us very poor results. In two of the early cases in our series of obstetrical paralysis, we put the plaster casts on the children and had their arms fixed in the abducted and fully supinated position for six weeks, and we had, and still have, a beautiful arthodesis of the shoulder joint. Dr. Steindler spoke of dividing the muscles; in these cases of paralysis, the ultimate result would not be good, he said. The result will be good, because gravity is working with it. We have in some of the later cases, where there has been considerable contraction, often taken off the coracoid process from the scapula. In a few cases, we have found it necessary to divide the acromion, because of posterior subluxation of the shoulder. That has been done in only a few of the older cases. Posterior subluxation when existing, has been the result of long standing contraction.

I was rather surprised at the position of the shoulder in regard to the arthrodesis. I have always been taught that it was better to have the shoulder not at a right angle and carried forward in this plane. As a matter of fact, the result was good. The play of the scapular muscles with gravity takes care of the position; and in the two cases following infantile paralysis, the parents were well pleased, and both children were better. Their function was better but their arms were outwardly rotated, rather than inwardly rotated, which did not make the ultimate position so good.

In connection with obstetrical paralysis cases, we found that the greatest factor in failure to obtain full function of the shoulder was lack of early motion.

DR. EMIL GEIST, Minneapolis, Minn.: Dr. Steindler is a pioneer in the question of tendon operations on the upper extremity, and I cannot join in the discussion, because my experience is not extensive enough.

Regarding subdeltoid bursitis, I will substantiate what Dr. Sever has said. I have stopped operating on these cases, for two patients who had these cal-

careous deposits and who refused operation got well, not only clinically, but also the calcareous deposits disappeared as time went on, as was shown by the x-ray. Dr. Steindler's paper shows that arthrodesis of the shoulder is an extremely satisfactory operation. Dr. Steindler's method of approaching the joint is a genuine advance.

Regarding the question of ischemic contractures, I was surprised at the uniformly good results which Dr. Steindler obtained following extensive lengthening of the various tendons on the flexor surface of the forearm. My experience has not been so good in this type of operations. Those cases in which we achieved good results, were done by the method shown by Sir Robert Jones at the last meeting of the Orthopedic Association that he attended, in 1910,—the method of gradual correction.

In arthrodesing a wrist, I do not only what Dr. Steindler does, but also what Dr. Ely does, put a bone graft into one of the metacarpals, cross the wrist, and include the lower end of the radius.

SIR ROBERT JONES, Liverpool, Eng.: While it does not very much matter in the child how extreme the abduction of the arm in arthrodesis, in the adult it does. In the child the scapula is so accommodating that the arm can be brought to the side. In the adult if abduction is extreme, the patient will never be able to bring his arm to his side. This is a most objectionable deformity. I hesitate very much before I arthrodese an adult arm for paralysis of the deltoid. This is especially the case in women who want to do their back hair and fasten their dresses. These women with paralyzed deltoids are very handy with their arms, for they place the hand of the bad arm into position, either by a swing or by means of the other hand.

DR. WALTER G. STERN, Cleveland: There are very few operations that have given me as gratifying results as the ones Dr. Steindler describes. It is amazing and surprising to see what the children can do with their shoulders after an arthrodesis has been performed.

I have given up the open operation for subdeltoid bursitis, because twice I have had the following experience: The x-ray showed what seemed to be calcareous deposits in the infraspinatus tendon, and upon excising these I found the deposits were soft, yellow, cheesy masses. The pathologist reported that the condition was a form of adipocere, or pure chemical fat deposits that had been changed. That is why we can see supposed calcareous deposits in this region appear and disappear so suddenly under local treatment, without any operative interference whatsoever.

DR. FRED H. ALBEE, New York City: In regard to the question of position after arthrodesis at the shoulder, I would say that I have done a large number of arthrodeses at the shoulder, and can confirm what others have said, that it is a very satisfactory operation. Success following this operation is very largely dependent upon fixing the arm in such a position as will allow scapulo-thoracic motion to compensate for the loss of motion at the shoulder joint. This is best accomplished by arthrodesing the joint with the upper arm in a posture of anterior elevation at right angles with the trunk, with the scapula in a neutral position flat against the chest wall. The humerus should also be rotated at the shoulder, so that the forearm, when flexed at the elbow, is directed upward. I have devised my Fracture Orthopædic Table so that the upper extremity can be held in this posture with or without traction throughout the operation and the application of the post-operation plaster-of-Paris shoulder spica. It seems that the most important function is the ability to bring the hand to the midline of the body, the hair, the mouth or the necktie. The posture, which I have been using for some years, and herein described, restores function more completely than any other.

I cannot see the wisdom of using metal wire as a fixation bone ligature. I cannot see why heavy kangaroo tendon would not do as well and hold as

long. Putting in a peg graft through the acrominon process and into the humeral head would hasten union and be an advantage, because confinement by immobilization splints would thus be reduced.

DR. ARTHUR STEINDLER, Iowa City: I am much more concerned with principles at this stage of the game than with technical details. I should be very glad to adopt any modification of the technique, which I know to be incomplete from every angle.

With regard to the position that the arm should be given in arthrodesis, I should not care to give it outward rotation, because I do not know what muscles could take care of the inward rotation after the arthrodesis is completed. I realize that it is perfectly true that in adults the range of the shoulder motion is less than in children, and abduction must be less than 90 degrees. In children, I felt that the angle of 90 degrees was permissible.

PRESENT TENDENCIES IN THE TREATMENT OF CONGENITAL CLUB-FOOT.

BY EBEN W. FISKE, A.M., M.D., PITTSBURGH, PA.

REGARDLESS of the abundance of literature on the subject, very little that is essentially new in the treatment of congenital club-foot has been advanced in the last thirty years. Moreover, the trend of treatment has been by no means universal, although certain aspects have gained favor at intervals—the brace method, largely used in the preoperative days, the corrective operation, and the essentially non-operative, manipulative treatment. The latter two, at least, are in present use, although their underlying principles are essentially divergent. The question naturally arises if long-standing, fundamental theories have not yet been proven out by practice, and if between these methods there does not lie a definitely indicated choice. It has seemed that the collective opinion of representative orthopædists, based on a questionnaire, might offer some guidance in this direction. Sixty-six replies were received and have been numerically compiled in answer to each question.

The first question, "At what age do you prefer to begin treatment of congenital equinovarus?", found 90% in favor of beginning in the first month of life, and three-fourths of these in the first week. Only four men would wait longer than three months. In reply to the second question, "What method do you employ in your youngest cases?", all manipulate in the beginning, all but three following with fixation,

plaster of Paris being used by the majority—40. First treatment under anesthesia is used by three men, two of them operating. The preponderance of opinion in favor of immediate treatment of the newborn child, whenever possible, and of the manipulative or non-operative method at this age, is therefore obvious.

The third question brought the age limit to six months, with the query, "Under what conditions do you use tenotomy and forcible correction with anesthesia in cases under six months?" The replies to this question may be placed under three groupings: those who employ these methods only in exceptional circumstances, those who use them much more freely, and those who are opposed to them at this age. In the use of tenotomy, fourteen employ it for severe cases, twelve for a resistant tendo Achillis, and five would tenotomize if the patient came from a distance. Three would divide the tendons if the condition were moderately severe, one usually does, and one always does. On the other hand, twenty-eight never cut at this age, and three but rarely. Similarly, forcible correction with anesthesia is favored by nineteen for extreme cases, by seven in most cases, while thirty-six are against the procedure. Up to the age of six months, then, the majority (56%) are opposed to operation or anesthesia, with most of the remainder (34%) conservative in their views, and but 10% who might be considered radical.

The same information was requested in the fourth question, which brought the age to two years and added the possibility of "bone or other extensive operations." At this age, or under, the majority (51) are conservative regarding tenotomy, performing it only in severe or complicated cases, while five will not cut at this age and ten tenotomize as a routine. For forcible correction, the same groups show thirty-five conservative, twelve against, and nineteen in favor. Bone or other extensive operations at this age are opposed in two-thirds of the replies, while the remaining third are conservative. None advise it as a routine. Comparing these figures with the preceding question, we find that the attitude of the majority (65%) toward tenotomy and forcible correction is here distinctly conservative, with 13% still opposed at this age and 22% favoring these methods. There is, therefore, a trend from the conservative to the operative treatment for the uncorrected club-foot in the second year of life, but it is also evident that the foot must present to the majority very urgent indications for cutting, and that more extensive operations than tenotomy are definitely opposed by most, and favored by none.

The fifth question was, "What is your general method in older or relapsed cases? What operative procedure do you find most successful?" The replies to this show that thirty-four generally employ radical bone operations, while twenty-one follow lesser measures by a bone operation only if the former fail, and twenty-four do not perform radical operations, eight of these still employing strictly non-operative methods. Several of the men recommend more than one method, depending on the age or type. Of the operations employed, forty-one perform cuneiform tarsectomy or osteotomy of the tarsus, nine prefer the Ober operation, three the Phelps, three Hoke's, and seven miscellaneous or original operations, a few using more than one. Operations more extensive than tenotomy, therefore, find favor in the treatment of the oldest or most difficult cases, although the majority do not prefer this method, and 30% never employ it.

In replying to the question as to what form of apparatus was used for correction, the majority (37) used none, and twenty-three used plaster of Paris as a corrective appliance. There were but five who used any kind of brace, which very clearly shows that the use of splints for correction has been generally abandoned. On the other hand, for retention, twenty-nine do not use braces in most cases (28 of these using plaster), while forty-three employ various forms, the T-strap shoe brace and Taylor brace being in the majority. Ten use their own types, four employ shoes only and four spoke of night splints. The majority, therefore, use braces for retention but not for correction.

If we may consider the foregoing at least suggestive of present tendencies in the treatment of congenital equinovarus, especially where there exists a definite consensus of opinion, there must be, then, some well defined reason for such uniformity. Practically no question, for example, arises as to the value of the earliest possible treatment, and very little as to the method of its application. The fundamental principles of the prevention of deformity must guide us here, as elsewhere, in the earliest prophylactic measures. True, there is here a deformity already existing, not one to be forestalled, yet at birth we have none of the secondary changes which must accumulate with every day of extra-uterine life. From the standpoint of prevention, then, it is expedient to lighten future labors by immediate measures. For the same reason, correction of the deformity permits of no postponement. The soft, elastic tissues of the infant's foot are most favorable for correction, and its factors are advantageous in inverse ratio to their duration. Early reshapement can be readily affected, and advantage taken

of the rapid growth of the foot during the first year. If the foot grows straight, it will stay straight.

Arguments against the earliest treatment are necessarily few, yet they are heard. The most valid objection is based on contra-indication from the poor general condition of the child, due to illness, nutrition, or congenital handicaps. This is a legitimate argument, but it should not operate for any extended period, except in the most unusual instances. It is hard to conceive of a condition so detrimental that something, such as daily manipulation, cannot be carried out, and it is in few cases that the proper gradual non-operative treatment by successive manipulation and fixation cannot be performed with little or no effect on the health. Certainly if the child gives evidence of continued disability, it is not reasonable to postpone early treatment of a mild character for later treatment which must be far more drastic. It is held by some, too, that the infant's foot is too small and fat to enable proper grasp with the fixation appliances, notably plaster, and that a larger, better developed foot may be more easily wrenched into position. Such an objection is invalid in view of the relatively simple technique of early redressment, once mastered. The objection that an early corrected foot is difficult to hold corrected till the walking age, and should therefore be postponed until that time, merits much the same reply. A foot properly over-corrected at the age of three months can be kept over-corrected, with a constant increase of normal development and growth, by the simple expedient of alternating periods of fixation and freedom, which, combined with external elastic traction and massage, will almost always preserve the desired correction through the first year. If we keep the foot growing straight, it will be ready to functionate straight at the normal walking age, with the inestimable advantage of earlier corrective weight-bearing. This is just as important at this stage as early correction at the age without weight-bearing, thus eliminating all such deforming tendencies.

As to the method of application of this earliest treatment, there is again almost complete unanimity. Certainly manipulation must be thorough and frequent, for this is our real corrective agency. Yet to rely on manipulation alone is often a fallacy. Only the mildest foot, perfectly controlled, will respond to the point of continued over-correction without some retention. In the vast majority, and this must include the dispensary cases, alternate manual correction and fixation must be employed. For the latter, plaster of Paris stands preëminent, both as a corrective and a retentive appliance. The old style corrective braces were too selective in their application of force,

too cumbersome and complicated. The later, simpler models, mostly used for the early correction of varus, seldom achieve complete over-correction. Adhesive plaster has its merits in mild or early cases, or as an intermediary between plasters, but its universal application is disappointing. Plaster, properly employed, grasps all the structures of the foot, or any particularly resistant portions, as desired, maintains the maximum position gained, and is proof against subsequent slipping or interference. It should not cause atrophy and retarded growth, as sometimes claimed, if the proper technique is carried out. Immediate treatment obviates long incasement in plaster—early stimulating measures will overcome such slight untoward results as may arise from this treatment.

Coming now to the question of more radical measures in club-foot cases first seen at a later period after birth, it must be first observed that two groups of cases have been generally recognized, those seen very early, for which non-operative measures are proper and sufficient, and those seen at an older age, for which either operative or non-operative procedures, or both, may be used. Between these methods, individual choice varies, and controversy has arisen both as to the circumstances determining this choice and whether there is justification for more than one method. If we should use none but the most conservative measures in an infantile club-foot, should we employ more radical measures in an older foot, and if so, when?

A reply to this inquiry has been suggested in the answers to the third question. For the untreated case at six months or younger, more than half oppose any cutting or corrective measures sufficiently radical to require anesthesia, while most of the remainder would employ such methods only when they have failed with the conservative treatment. Evidently, the evils of traumatism cannot be overlooked by the surgeon whose object is ultimate restoration of the foot to normal function. The deformity of equinovarus is entered into in various degrees by practically all the structures of the foot, even in the earliest foot. No one tissue or part is at fault, and treatment must be directed to the whole foot, not localized as it must necessarily be by operation. Even a measure so simple as tenotomy cannot but weaken the muscle, while rapid forcible correction depends for its success on a tearing of the least resistant structures with definite functional impairment, and little or no corrective effect on many other elements of the deformity. Not only for these reasons, but also because of ease in application and the assurance of good results, non-traumatic methods are generally conceded to be indicated for the earlier club-feet. One exception only

can be made to this. Where absolute control of the case is impossible, due to inability of the parents to return frequently enough for proper non-operative care, as when living at a great distance, or when intelligence or coöperation might be questioned, milder radical measures may be necessary.

The main controversy, then, seems to lie between the application of operative and non-operative procedures in somewhat older cases. Here we are confronted with an established deformity, involving bones, joints, ligaments, and muscles. What is more natural than the tendency to overcome these difficulties by direct attack on the individual hindrances to correction, or at least on the more obstructive ones? Cut a few tight muscles, release a shortened ligament here and there, remove a bone block, if necessary, and force the foot straight. Surely this is not difficult, and if sufficiently complete, quite a normal appearing foot may result. But is a cosmetic result the end in view? If external form determined function, our result might be quite happy; but unfortunately function presupposes structural integrity. Should we, moreover, overlook the biological principle that it is function that has determined form?

If the establishment of normal action is, then, of prime importance in our conduct of these cases, where is the rationale of destructive measures in treatment? To what good purpose is the production of tissue matted by scar, binding and inactivating tendons important in locomotion, impairment of muscular action and balance by repeated tenotomies, interference with growth and development by injury to nerves and vessels, stiffening and shortening an already stiff, short foot by extensive removal of bone, further weakening of a weak member by the rupture of valuable ligaments?

It would seem, rather, that such complications should be avoided, that each step in the mechanical correction of the deformity should be taken with the definite object of restoring the usefulness of the foot, and that the slower manipulative method, which gradually reshapes the soft parts and bones without danger to the patient, without damage to any of the structures or interference with the circulation or growth, without loss of muscle tone or innervation, would more surely favor ultimate restoration of normal function along with normal form. During all of childhood, the tissue and bones are plastic, advantage may be taken of growth, and walking may be made an active agency in correction. To one who has observed the results of careful and persistent non-operative measures in older cases, the question would rather arise as to what age limit could be imposed on the

effectiveness of this treatment. Particularly is this true in the older or relapsed cases, in which, because so much trauma has already occurred, it is fair to consider the difficulty of correction often greater than in untreated cases of the same age. Here, certainly, the indication is to preserve and foster all the structures which have not been hopelessly damaged, by constructive rather than by destructive measures. The results in such cases, as well as the effectiveness of conservative measures in other types, together with the details of treatment, are omitted from this discussion, as they have been previously reported.*

It is not unfair to assume that the above principles have influenced the answers to the fourth and fifth questions. Despite the fact that more men favor operation in cases up to two years of age than in cases under six months, this increase is slight (20%) in view of the very great difference in the difficulties presented by the cases at these ages, and the majority still cling to non-operative measures as long as they can make them effective. As to more extensive operations than stretching and tenotomy, the majority are not only distinctly opposed to this treatment in cases up to two years, but are also definitely conservative toward destructive measures at any age. The best indication for extensive operative methods would seem to be a failure of conservative treatment, and this can be largely avoided by a better mastery of the manipulative technique for all ages. Only on such a basis of expediency as previously noted for tenotomy in the infant can we condone radical cutting of the foot. Undoubtedly the element of time may be a factor in the older cases, especially the adults, although the proper retentive stage after operating is often quite as long as that of the entire non-operative treatment. Certainly in the growing foot, it takes as long to develop all the structures into new shapes and positions after a few have been cut, as it does to reshape the entire foot by a procedure which from the first is designed to do just that thing. Only when growth has stopped, may we question the efficacy of gradual correction upon resistant bones and joints.

The reply to the sixth question indicates the almost universal use of the brace for retention of the foot after full over-correction has been obtained. In this stage, as in the previous, our whole object should be the restoration of normal action and strength, for this will prevent relapse as no other measures can. With the omission of plasters, ac-

* "The Prognosis of Congenital Club Foot and Its Relation to Non-Operative Treatment." Jour. A. M. A., July 31, 1915, Vol. lxv, pp. 375-380; "The Conservative Treatment of Congenital Club-Foot." Am. Jour. of Orth. Surg., December, 1916, Vol. xiv, pp. 693-707.

tive physiotherapeutic measures can be begun in a systematic manner, especially applied to the muscles previously weakened and overstretched. All apparatus at this stage should be the lightest and least constricting possible, and conform to the natural requirements of walking, with the weight thrown into the position of continuous overcorrection.

Obviously, the important factors in the treatment of club-foot are the proper selection of treatment and the persistency with which this treatment is carried out, and to each of these equal weight must be given. Conscientious individual effort must always be rewarded, though much facilitated by an efficient technique. For the latter, two requisites would seem essential. First, as strict an adherence as possible to the principles of non-traumatism at all stages, regardless of any apparent indication for more drastic interference. If we are correct in assuming that damage to any structure tends to impair its usefulness, then the application of this theory must be carried out in every detail. Second, a thorough understanding of the measures available for conservative treatment during correction, overcorrection, and retention, these being manipulation to the point of tolerance, plaster or other mechanical fixation, corrective weight-bearing, massage and exercises. Advantage must be taken of all favorable factors present in the foot, with special reliance upon growth and the stimulation of such muscular forces as will favor overcorrection as the reshapement proceeds. The aim of treatment must be to reactivate the originally overstretched muscles and ligaments, until they outbalance their previously contracted opponents. By this means, the active factors in relapse, namely the failure to obtain perfect over-correction, and to maintain it, will be rendered permanently ineffective. This is the essence of the conservative, functional treatment.

There is little that is inherently difficult in the treatment of equinovarus, but many misapprehensions may allow it to become difficult. The pathologic anatomy of club-foot is interesting and important, yet its intricacies are unnecessarily complex if we realize that it does not matter what is contracted or deformed, so long as the deformity as a whole is so attacked that all its intrinsic parts are simultaneously and equally corrected, and kept so. Consistent preservation of the natural endowments of the foot and avoidance of injury will compel its normal restoration by growth, accompanied by increasing activation in all its parts. It is in the direction of this more rational theory of treatment that our present day conduct of congenital club-foot appears to be tending.

DISCUSSION OF DR. FISKE'S PAPER.

DR. OSGOOD: The discussion on this paper, which is a very judicial and temporate review of the subject, will be opened by Dr. Albert Freiberg of Cincinnati.

DR. FREIBERG, Cincinnati: *Mr. President, and Gentlemen,*—Dr. Fiske's résumé of the treatment of congenital club-foot is so complete and so much in accord with my own ideas on this subject that I shall not say much. The desiderata which we must seek have not been quite stated by Dr. Fiske as I should state them. We must demand that the individual shall be able to dorsally flex his foot well beyond a right angle, and that he shall be able to pronate it with his own muscles. It seems, furthermore, that nothing will reshape the foot so much as function in the overcorrected position. How much can be done by merely manipulating and stretching the foot, without operations upon the bones, is not generally understood. We may use mechanical aids for this purpose, if we know how to use them. The matter of age does not frighten me because I have successfully corrected the severest kind of club-foot in a man of twenty-nine years who threatened to end his existence because his life had become a misery to him. He is now earning his living as a tailor, with his feet in dorsal correction, and can pronate with his own muscles. It would have been a great error to take out the astragalus in this man and leave a crippled foot, as I have seen done. The art lies in thorough manipulation of the foot and completely stretching the soft parts until they have lost their elasticity. This pertains to the feet which have not been butchered up by someone else, without result. With this class of feet, we have different problems. We have cicatricial bands, the results of trauma, in which cases I admit the aptness of such operations as Dr. Ober's. I shall have to admit the correctness of operations on the bones for some of these cases, but they will be few indeed. In my experience, the procedure has consisted of manipulation of the foot until it is in an overcorrected position and retaining it with plaster dressings in which the patient walks. Until he can dorsally flex his foot and pronate it with his own muscles, this must be continued, no matter how long it takes. When this can be done, we may speak of a cure, although corrective manipulations should be made daily for a long time after corrective dressings have been discontinued.

DR. FRANK OBER, Boston, Mass.: The causes of relapse is the thing which troubles most of us and it may occur after a considerable interval in a patient who has had a satisfactory overcorrection.

We will all agree with what Dr. Freiberg has just said, "A club-foot is cured when the patient can voluntarily overcorrect his foot in the pronated position." To my mind the chief obstacle to overcorrection is an inverted os calcis, and as this bone is held inverted by the thick, strong, internal lateral ligament the difficulties of pronating it are very great, especially in older children.

It seems to me that most of us are too easily satisfied with our results and therefore treatment is discontinued too soon and braces which do not overcorrect are applied too early.

Overcorrection should be maintained while the child is asleep, and after the retentive apparatus is removed the foot should be manipulated manually several times a day, at the same time teaching the patient to use the stretched peroneal muscles so that the position of valgus may be maintained voluntarily.

SIR ROBERT JONES: I am in absolute accord with Dr. Freiberg. We should recognize the causes of failure. The first is inefficient reduction, the second overlengthened tendons, and third the wrong alignment of body weight applied to the foot. Recurrences usually mean ineffectively treated club-feet, not always, but generally.

No matter how mobile a foot is in the surgeon's hand, unless the child has complete voluntary power to overcorrect its deformity, the foot is not cured.

One of the defects in manipulated club-feet is that knock-knee has been produced. This is due to bad technique—the epiphysis of the ankle and the internal lateral ligament of the knee should be prevented from being strained each time the foot is manipulated.

From early moments the twist of the tibia and fibula which so often accompanies club-foot, should be attended to by appropriate manipulation. Unless this be done the result when the child walks is appalling. We should overcorrect the deformity, see that the child can voluntarily overcorrect it, and walking should be permitted in flat-heeled boots without any apparatus. Let us hope that the days are passed when the so-called cure of club-foot involves the use of cumbersome and hideous harness.

DR. FRED J. GAENSLEN, Milwaukee: I hesitate to take up your time after this presentation and discussion, but wish that Dr. Fiske could have dwelt in greater detail on his technique. It consists essentially in gradual manual correction of the deformity, each successive step in the correction being maintained by means of a light plaster cast applied over a single layer of flannel glued to the skin. When the plaster is applied over thick layers of sheet wadded much of the correction obtained is lost and not infrequently the casts are kicked off or the foot is partially withdrawn from the cast with resulting distortion of the foot. The method is also useful in correction of foot deformity preparatory to tendon transplantation.

END-RESULTS IN THE OPERATIVE PROCEDURES FOR INFANTILE PARALYSIS, WITH SPECIAL REFERENCE TO TENDON TRANSPLANTATION AT THE WIDENER TRAINING SCHOOL FOR CRIPPLED CHILDREN.

A. BRUCE GILL, M.D., PHILADELPHIA.

CHILDREN are admitted to the Widener Memorial Industrial Training School for Crippled Children between the ages of four and ten years, and are discharged when eighteen to twenty years of age. They are therefore resident in the School for periods of between eight and sixteen years, with the exception of those who are discharged for one reason or another before they have completed their academic and industrial training. The population is limited to one hundred. While these circumstances greatly limit the number of crippled children who can receive the benefits of the School, they render possible a long continued observation and training under absolute control and permit of such complete orthopædic care as is possible in but few other institutions of this country and not at all in our hospital or private practice. Unusual opportunity has thus been afforded for accurate

observation of the results of various operative procedures in the treatment of infantile paralysis during the fifteen years since the School was opened. No children are discharged or graduated if it is evident that anything more can be done to improve the function of their crippled members. Many have been operated upon four, five, and six times.

It has been the writer's privilege to maintain continuous service in the School for the past fourteen years as Resident Physician, Assistant Surgeon, and finally Chief Surgeon.

The end-results of the operations performed upon one hundred and sixteen children are tabulated in the following pages, evident conclusions are drawn, and the measures which experience has proved valuable and which are now employed in the correction of the various deformities and disabilities of infantile paralysis are recited.

This series of fifty-nine operations of tendon transplantation in the lower extremity includes only those in which the transplantation was done primarily and uncombined with any other type of operation, such as subastragalar arthrodesis, or horizontal transverse section, or tendon fixation.

The operations marked successful required no subsequent procedure to correct deformity or improve function and the children were enabled to walk without the use of apparatus, except where a greater disability higher up forbade.

Some of the improved cases presented so slight residual deformity that further operation was not justifiable, while others required secondary operation. In the latter class it was evident that the tendon transplantation was of value in the final correction. This was particularly apparent at the knee. The muscle transplanted to take the function of a paralyzed quadriceps was unable to extend the leg against gravity, but greatly aided in stabilizing the knee after an osteotomy of the femur had been done to make a back knee. In all of these cases the patient was enabled eventually to walk without apparatus.

In the six instances in which an original pes valgus was transformed into a pes varus there was a period of from one to four years following the operation during which the foot presented no deformity. On the first appearance of the varus the feet were manipulated under an anesthetic and put up in a plaster in a position of valgus. But always the varus recurred. Retransplantation of some of the tendons, combined with subastragalar arthrodesis, and even wedge resection of the tarsus was required to secure permanent correction.

In the unsuccessful cases there was complete failure to correct deformity or improve function. A few of them showed some improvement for a time, but relapse followed, while in others the muscles continued to show some power, but insufficient to influence the member. For example, an apparently normal extensor proprius hallucis transplanted to take the place of a paralyzed tibialis anticus is usually unable to overcome the established deformity or to prevent its recurrence if corrected; eventually it becomes overstretched and acts but feebly or not at all.

Therefore, the results of tendon transplantation for deformity of the foot when uncombined with any other type of operation would appear to be uncertain. In this series, 22% were successful, 11% improved, and 67% failures. The same muscles transplanted in the same manner and by the same technique sometimes produced correction, sometimes overcorrection, and sometimes no effect at all.

The lateral muscle balance of the foot seems to be delicate, and once disturbed by paralysis, is not easily restored by surgical intervention. Unless balance is fairly even the foot will in time incline to one side or the other; and when inclination once appears its progress to marked deformity is fairly rapid.

If lateral motion of the foot, which occurs chiefly in the subastragalar joint, *i. e.,* the articulation of the astragalus with the scaphoid and the os calcis, were necessary to standing and walking, we should be justified in continued attempts to preserve it. But cripples who have had an arthrodesis of the subastragalar joint have quite good function of the foot, which is able in walking even to accommodate itself to inequalities of the ground through the joints anterior to the astragalo-scaphoid articulation. Since, therefore, it is difficult to secure balanced lateral motion, and since it is not an absolute essential, is it not wise to correct lateral deformity by the abolition of lateral motion and to employ whatever power is present in improving antero-posterior function? Must we not recognize that a foot which has been permanently crippled by infantile paralysis can never, by any manner of means, be restored to its original condition? Something is gone forever. In some cases, it is true, motion may be preserved or restored in all directions fairly effectively. In others the balance of power has been so seriously disturbed, or the residuum is so slight, that it is futile to attempt to preserve all motions with good function. In such cases it seems best to eliminate the motion which is the least essential and use all muscles for the more useful one.

If, however, lateral motion is eliminated by a sub-astragalar arthrodesis and there remains an unbalanced lateral muscle tension, the arthrodesis will remain solid, but lateral play and deformity will appear in the ankle joint. Indeed, it is at times observed in cases of marked pes valgus, whether the foot be flail, or whether power be present, that while the greater portion of the deformity is in the subastragalar joint, a part of it is in the ankle. This can be easily demonstrated by grasping the astragalus and moving it from side to side, or by correcting the subastragalar deformity manually or by operation and then observing how the foot which is straight passes into valgus on dorsiflexion.

Therefore, to perform a subastragalar arthrodesis alone when there is marked lateral muscle unbalance is not sufficient. While we utilize all power in the foot for plantar and dorsal flexion, we must so distribute it that a fairly even pull is made on both sides of the foot or centrally over it. The peroneus tertius, together with the extensor communis digitorum, will not only dorsiflex the foot, but will pull it into valgus unless balanced by power that will elevate the foot on the inner side or unless these tendons are made to act centrally over the dorsum of the foot. The extensor proprius hallucis, or a peroneus tertius may be used to supply power to the inner side of the foot. The Whitman loop operation not only transfers power to the inner side through the transplanted peroneus but also centralizes the dorsal pull of the extensors of the toes. However, in my opinion, this operation, for several reasons, should always be combined with a subastragalar arthrodesis. I have so employed it with splendid results as far as can be judged at this comparatively early date.

In combined lateral and antero-posterior deformity the lateral motion should be abolished, and attempt made to secure muscle balance in plantar- and dorsiflexion.

In equino-varus, in which there is paralysis of the tibialis anticus, the common extensor, and the peronei, and power in the triceps, or tendo-Achillis, and the tibialis posticus and possibly the extensor proprius hallucis, a subastragalar arthrodesis, and fixation of the common extensor into the tibia, may produce a fair result. Various other combinations may be employed as well. But when a strong triceps has nothing to balance it in front there is no operation which fully and uniformly solves the problem. Anterior tendon fixation can scarcely be expected to hold against the strong and constant pull of the tendo-Achillis, and arthrodesis of the ankle destroys its function. A com-

plete and solid tendon fixation, if such be possible, does practically the same thing.

Equinovalgus with power only in the peronei and the triceps, while rare, presents much the same difficulty. But one peroneus may be transferred forward of the external malleolus without detachment from its insertion, so that it may act as a dorsiflexor. And the other peroneus may be transplanted to the inner side of the foot. In one case in this series the peronei were both transferred forward of the malleolus without very good result. Subastragalar arthrodesis is to be combined with this operation.

Pes calcaneus should be corrected by a horizontal transverse section or an astragalectomy. While we employ the former we by no means belittle the latter. In addition, the tendo-Achillis may be fixed into the fibula. One such fixation was done with perfect result. If valgus is also present, due to power in the peronei, these tendons should be transplanted to the os calcis. Anterior power should be balanced so far as possible.

If the foot is flail, the so-called dangle-foot, a horizontal section or astragalectomy will stabilize it. But if the entire extremity is flail, a combined subastragalar and ankle arthrodesis will stabilize the knee as well as the foot.

SUBASTRAGALAR ARTHRODESIS.

Successful, requiring no subsequent operation to correct lateral deformity, or to stabilize the foot.		
In flail feet	31	
Combined with tendon transplantation	6	
Following unsuccessful primary tendon transplantation	6	
Combined with Whitman loop operation	1	
	—	44
Unsuccessful, requiring subsequent operation for lateral deformity		
In flail feet, due to putting foot in plaster in faulty position after operation	4	
Developing subsequent to operation and due to unbalanced muscles	5	
Due to lateral deformity in ankle	7	
	—	16
TOTAL		60

The sixteen cases in which lateral deformity was not altogether cured by the primary arthrodesis were subsequently corrected. If the deformity is at the site of the arthrodesis, the surgeon can readily by means of a gouge make a section through the foot beneath the astragalus in the same plane as that of the primary operation, loosen the foot from the astragalus, and fix it in plaster in the desired po-

sition. No elements of the foot have been destroyed or removed by the arthrodesis. The ankylosis can be broken up at any time and the foot placed in correct position. This is a great advantage of the operation. "If at first you don't succeed, try, try again!" In this series a second section was done eight times, and a third section once. In three cases tendons were transplanted subsequently to balance muscle pull. In thirteen patients subastragalar arthrodesis and ankle arthrodesis were done simultaneously, or at different times.

Never was there a failure to secure ankylosis.

An inversion and adduction of the anterior part of the foot is at times observed in cases in which the posterior part of the foot has been cured of its pronation. This is probably the persistence of the rotation of the antitarsus which is an element in a pronated foot. It can usually be corrected by vigorous manual manipulation; or, if not, by a vertical section through the foot in front of the astragalus.

HORIZONTAL TRANSVERSE SECTION.

Successful, requiring no subsequent operation		
In flail feet	11	
Combined with transplantation of peronei to os calcis	8	
Subsequent to tendon transplantation	2	
Combined with fixation of tendo-Achillis to the fibula	1	
	—	22
Unsuccessful, requiring subsequent operation		
Second section to displace foot backward	4	
Second section for lateral deformity	1	
Ankle arthrodesis for lateral deformity	1	
Ankle arthrodesis to correct calcaneus	2	
Ankle arthrodesis and osteotomy of femur to stabilize the knee	4	
	—	12
TOTAL		34

HORIZONTAL TRANSVERSE SECTION.

Horizontal transverse section of the foot, like subastragalar arthrodesis, can be repeated if the primary result is unsatisfactory. The early operations were little more than an arthrodesis because the foot was not displaced far enough backward to eliminate completely the calcaneus deformity. Those done in recent years with improved technique have proved almost uniformly satisfactory.

The best function is obtained in those feet in which good peronei are transplanted to the os calcis when the horizontal section is done.

In the earlier years at the School arthrodesis of the ankle was performed for pes calcaneus, but was discontinued when it was learned that other operations give better results.

OPERATIONS AT THE KNEE.

The problem of stabilizing the knee so that the patient can bear weight without apparatus varies with the condition of paralysis present in the extremity. If there is strength in the gluteal muscles the patient may walk well though he have no power below the hip joint. He can go up and down stairs even with moderate contracture of the knee. But he walks better if the knee hyperextends at each step. The contracture may be manually corrected under an anesthetic but will frequently recur; so that after numerous attempts thus to secure a permanent back-knee, the surgeon is forced to do an osteotomy of the femur above the knee and bend it backward. The osteotomy is usually required primarily in patients over twelve years of age who have had a long continued contracture.

Knock-knee is frequently present and should invariably be corrected, even though quite moderate. A combination of genu-valgum and flexion contracture constitutes an exceedingly weak position, and their correction alone will enable many a patient to walk.

The ilio-tibial band is frequently shortened and is a strong, possibly the chief, deforming element. The external intermuscular septum participates in the contracture. Both must be divided by the scalpel.

If the entire extremity including the gluteal muscles is flail, the problem is difficult. It may be met by ankylosing the ankle with the foot at an angle of one hundred to one hundred and five degrees with the leg, and by hyperextending the knee. When the body weight then falls upon the ball of the foot it forces the heel to the ground and drives the knee backward because the ankle is rigid. Thus the weight of the body is made to sustain itself.

ARTHRODESIS OF THE ANKLE AND OSTEOTOMY OF THE FEMUR.

Arthrodesis of the ankle has been performed forty-nine times to stabilize a flail extremity; seventeen times alone, and thirty-two times in combination with an osteotomy of the femur. In all cases before operation the patient walked with a lock-joint brace or by holding his knee back with his hand. Thirteen of the seventeen and twenty-one of the thirty-two, a total of thirty-four out of forty-nine, subsequently walked without apparatus or without holding the knee or touching the thigh with the hand.

The children who were obliged to continue the use of lock braces were for the most part those with complete paralysis of both lower extremities, weakness of the muscles of the back, and in some instances subluxating hips.

OSTEOTOMY OF THE FEMUR.

Total operations	57
Braces no longer required	38
Braces required	19
Osteotomy repeated once in same femur	10
Osteotomy repeated twice in same femur	1

Almost all these cases were first forcibly extended, but either deformity recurred or knock-knee was present.

TENDON TRANSPLANTATION AT KNEE.

In the less severe cases that present quadriceps paralysis with power in other muscles of the thigh, it is well worth while to transplant a suitable muscle to substitute for the quadriceps, provided always that hyperextension of the knee is secured and knock-knee corrected.

A good sartorius will give a splendid result. In this series of cases it failed once out of five times, only because it had very slight power.

The biceps and the semi-membranosus, if properly transplanted, also are useful. The author prefers to use the biceps because it can be made to pull in a more direct line than can the internal hamstring.

Nor is the tensor fasciae femoris to be scoffed at. In this series it was transplanted once by Lange himself by his silk-tendon method, and three times by the Kofmann operation. The latter gives the better result. A strip of the fascia lata a half inch in width from the insertion of the tensor fasciae femoris down to the knee joint is moved inward like a tendon and sutured to the patella. Its assistance, though moderate, may be sufficient to stabilize the knee. In all three cases, it exerted an active voluntary pull on the patella and was almost strong enough to maintain the knee in extension against gravity.

ROTATION OF THE LOWER EXTREMITY.

Some patients walk with one or both of the lower extremities in marked internal or external rotation. Dr. G. G. Davis's method of fixation of the fascia lata to the great trochanter of the femur was done seven times, in six of which it was completely effective in maintaining the extremity in a straight, or neutral, position.

STABILIZATION OF THE HIP.

The class of cases mentioned as failing to secure stability through ankle arthrodesis and osteotomy of the femur present one of our most difficult surgical problems. Many of them must probably be satisfied to get about with lock-joint braces, with or without a pelvic band, and with crutches.

I have done an arthrodesis of the hip-joint in two patients. The hips were completely flail and frequently were dislocated in walking and caused the child to fall. The results in both instances have been very favorable. The arthrodesis has been solid and painless, and the patients have much greater stability.

PARALYTIC SCOLIOSIS.

Bone transplantation has been performed seven times, the first operation being done five years ago. The results are encouraging. The children have been enabled to sit erect without supporting themselves by the hands. They are able to feed themselves, to dress, and to use their arms otherwise when sitting. These things they could not do before operation. The spines are held rigid and deformity has been prevented throughout the extent of the graft.

Where marked curvature exists the spine is first straightened in whole or in part by lateral traction in recumbency.

The technique employed is a combination of the Hibbs and the Albee methods of fixation. Complete dissection, denudation, and digging up of the spine are done after the Hibbs' method on the concave side. A bone transplant is then placed in contact with the laminae and the spinous processes are drawn and held in firm contact with it by strong sutures. This straightens the spine, and gives a firm permanent fixation.

Radical operation has been forced upon us after long observation of the terrible deformities which developed in spite of our best conservative methods of treatment.

FLAIL SHOULDER.

Silk ligaments were twice inserted through the acromion and the head of the humerus before we satisfied ourselves how foolish we were to expect such device to maintain the humerus in abduction to the

scapula. And for a long time the condition of flail shoulder seemed one of the insuperable handicaps to the cripple. But since we have learned how to do an arthrodesis of the shoulder we no longer dread to see this extremely disabling condition.

The value of the operation consists not only in the stability it gives the patient to raise his arm from his side, but in the much greater advantage of the complete control of the extremity and the ability to put the weight of his entire body behind his hand in pushing, pulling, lifting, and striking.

Heretofore we have been slow to admit to the Widener School children seriously paralyzed in the arms because such condition prevents their learning a trade. The perfecting of the operation of arthrodesis of the shoulder will probably enable the School to accept children it has heretofore refused.

Thus arthrodesis of the hip, the spine, and the shoulder, are attacking vigorously the last awful strongholds of infantile paralysis.

TENDON TRANSPLANTATIONS IN THE FOREARM.

Well considered tendon transplantations in the forearm are uniformly successful, because the elements of gravity and weight-bearing, so important in the lower extremity, are absent. The principles and methods of operation which determine the utilization of the power which is present to the greatest advantage I shall not here discuss.

Arthrodesis of the first carpo-metacarpal articulation to maintain a flail thumb in opposition and transference of power to the flexor longus pollicis is a most useful procedure.

These measures have been repeatedly employed and have enabled children to learn a trade, such as watch and clock making, and earn a splendid livelihood which would otherwise have been impossible.

Arthrodesis of the wrist should be considered in those patients who possess but slight power so that it may be employed entirely in movements of the fingers and thumb.

TENDON FIXATION.

Our experience with tendon fixation has been limited. Foot-drop was permanently corrected five times and relapsed eight times. Lateral deformity was corrected thrice and recurred once.

While a flail foot may be kept from dropping by fixation of the anterior tendons we can scarcely expect to maintain correction against

the pull of a strong tendo-Achillis. That tendons will stretch has been demonstrated by exploratory operation after the recurrence of deformity.

So frequently the dropping of the foot is combined with other deformity or instability which can be more certainly and simply remedied by an arthrodesis or astragalectomy as previously mentioned.

Our judgment is that the application of tendon fixation is limited, and that deformity and instability are for the most part better corrected by other means.

SILK LIGAMENTS.

Silk ligaments held a flail foot from dropping twice and failed thrice. They corrected a lateral deformity twice. In two cases they were inserted to fix a flail shoulder, and utterly failed.

Their use has long since been discarded.

PRIMARY TENDON TRANSPLANTATIONS UNCOMBINED WITH OTHER TYPES OF OPERATIONS.

	Successful	Partially successful Improved	Overcorrection	Unsuccessful Complete failure	Total
Pes valgus	8	1	6	18	33
Pes calcaneus	2	4		6	12
Quadriceps paralysis	3	9		2	14
	13	14	6	26	59

Pes valgus Tendons transplanted to the inner side of the foot	1-4th & 5th E.C.D. (Peronei also to) (os calcis) 2.4th & 5th E.C.D. & peroneus brevis. 3.4th & 5th E.C.D. & both peronei. 4.Peroneus brevis. 5.Peroneus longus. 6.Both peronei. 7-8. E.P.H.	1.4th & 5th E.C.D. & E.P.H.	1.4th & 5th E.C.D. & peroneus brevis (to tibialis posticus) 2.4th & 5th E.C.D. & E.P.H. 3-4-5.4th & 5th E.C.D. & both peronei. 6.E.P.H. and both peronei.	1-6.4th & 5th E.C.D. 7-12.E.P.H. 13-15.Peroneus brevis 16.Peroneus longus. 17.Both peronei. 18.4th & 5th E.C.D & E.P.H.
Pes calcaneus Transplanted to the os calcis.	1-2.Both peronei.	1.Both peronei. 2.Peroneus brevis. 3.Peroneus brevis & tibialis anticus. 4.E.P.H. and tibialis posticus.		1-3.Peroneus brevis. 4.Both peronei. 5.Tibialis anticus. 6.E.P.H.
Quadriceps Paralysis Transplanted to the patella	1-2.Sartorius. 3.Semimembranosus.	1-2.Sartorius. 3-4.Semimembranosus. 5.Biceps. 6-9.Tensor fas.fem. **Hofmann's operation		1.Sartorius. 2.Semimembranosus.

E.P.H. = Extensor proprius hallucis.
E.C.D. = Extensor communis digitorum.
Tensor fas. fem. = Tensor fasciae femoris.

* The peroneus tertius, when present, was always transplanted with the extensor tendons of the fourth and fifth toes.

** Zeitschrift für Orth. Chir., Band 33, 1913.

SUITABLE TIME AND AGE FOR OPERATION.

As a general rule only the operations necessary to the relief of contractures are done within the first three or four years after the onset of paralysis. All constructive operations are delayed until the child is seven or eight years of age, when tendon transplantation may be combined with arthrodeses. We formerly transplanted tendons earlier, but learned in time the futility of such procedure.

We see no necessity or advantage in waiting until the patient is twelve years of age and upward. To the contrary, deformities and disabilities may be so confirmed by that time that correction is difficult.

Finally, it may be said that the last word has not yet been uttered as to the operative treatment of infantile paralysis, and it behooves us all to keep an open mind and not to become so wedded to our own opinions that we would not change them for better.

DISCUSSION OF DR. GILL'S PAPER.

DR. JOHN L. PORTER, Chicago: In my experience with tendon transplantation, as done by others and myself, I have been impressed with the fact that has been brought out by Dr. Gill in his paper, that the failures were much greater than the successes. He called tendon transplantation a failure, when done alone, and unconnected with other operations. He has not attempted to explain why there is such a large proportion of failures; and I have asked myself why, in so many instances, it fails to accomplish what we hope it will accomplish. I have analyzed my own cases and studied many which I have seen, and it seems to me that the reasons may be considered under four or five headings:

First, an insufficient study of the mechanics of the deformity before the operation is performed. For instance, what doth it profit a joint to transfer all the muscles on one side to the other side, with nothing left to stabilize the joint on the side that you have sacrificed? Nothing. Yet we see it done frequently.

Second, the use of muscles that are inadequate to perform the duties that we require of them. Dr. Gill has spoken of that in speaking of the transplantation of the extensor proprius hallucis to the tarsus, to take the place of the anterior tibial. It is not strong enough to replace that muscle.

Third, the transplantation of the tendon before giving the weak muscles a chance to recuperate. I have learned, before transplanting any muscles or doing any operations on a case of infantile paralysis, to put the overstretched muscles, which have not functioned for months, in a state of relaxation, and give them a chance to contract, and hold them in that position for many months. I have been astonished to find, in cases where I expected to have to do an arthrodesis, that sufficient power would be developed, simply by giving them a rest in the relaxed conditon. Sir Robert Jones was the first who showed me the great importance of giving a weak, paralyzed, or supposedly paralyzed muscle a chance to recuperate.

Fourth, errors in technique, such as carrying the implanted tendons through tissues to which they must become adherent without the tendon sheath. So many times, the tendon sheath is stripped up to such a degree that adhesions cannot help forming, and in that way vitiate the result.

Fifth, more poor technique, in failing to attach the transplanting tendon firmly to the bone and periosteum. It is useless to transplant an active tendon to a paralyzed tendon, unless close to the insertion of the paralyzed tendon. The only way that I can get good results is to split up periosteum at the point where the tendon can functionate most satisfactorily, dig a little hole and bury the tendon in the bone, and then cover it with a flap of periosteum from each side. I have never yet seen a transplantation of the hamstring tendons to the sartorius, or to the patella, to take the place of the quadriceps, which was satisfactory and it seems to me that one of the important features that we overlooked in our early work, was failing to stabilize the joint in transplanting tendons. The tendon transplantation that has been most satisfactory to me has been the transplantation of the peroneus longus to the inside of the foot, to take the place of the anterior tibial or to help stabilize the joint, where both the perinei were active; and in transplanting the peroneus longus for that purpose the best success has been in dissecting up the tendon completely, with its sheath, clear up to its origin, splitting the intermuscular septum with blunt dissection, and carrying it down through the sheath of the tibialis posticus. Holding it in place a long time after the operation has given good success, because an active muscle is left on the outside, and putting the two on the tibial side makes a balance. It does work.

SOME POINTS ON IMMOBILIZATION TREATMENT OF SEPTIC KNEE JOINTS

BY FRANK R. OBER, M.D., BOSTON, MASS.

THE object of this paper is to present to you, in a more or less detailed way, some points which seem to me to be very essential in the immobilization treatment of septic knee joints.

MATERIAL.

The material was obtained from nearly one hundred cases of septic knee joints treated at the base in France in 1917 and 1918. A very large number of them had very extensive wounds of the structures concerned in the normal function of the joint and some of them had severe wounds elsewhere which complicated the treatment of the joint condition.

There were no amputations for sepsis, one amputation for gas gangrene of the thigh, three amputations for destruction of the great vessels followed by gangrene, one death from secondary hemorrhage and no deaths from sepsis.

GENERAL CONSIDERATIONS.

Mobilization treatment is ideal because it aims to secure a joint with normal function, but it has its limitations, a few of which follow: treatment should begin at the earliest possible moment, and before the membrane becomes thickened; it is necessary to have a joint potentially capable of active function, which means there cannot be any great destruction of bone and muscles; nurses and orderlies must be trained to carry out the treatment, as prescribed, at regular intervals, because ignorance and neglect always spell defeat. Therefore, as it is not always possible to overcome all these limitations we must sometimes fall back upon the immobilization method which is as exacting on knowledge and good care as the mobilization method. Success will be obtained only by a studious attention to all the minor details of management of the leg, splint, dressings, and patient from the beginning to the end of treatment.

PATHOLOGY.

Primary Pathology of the joint condition. Early, there is a simple empyema which is essentially a synovitis acting as a culture medium for organisms. Later on, the synovial membrane becomes thickened with granulation tissue and the recesses of the joint are walled off by adhesions, sometimes resulting in fibrous ankylosis and finally there is a severe type in which the cartilage and ligaments are destroyed, the joint excising itself, resulting in bony ankylosis.

Secondary Pathology means burrowing of the pus outside the joint structures. This is a complication and is encouraged by the shape of the bony structures forming the joint and the relation of the attached synovial membrane to these structures. It probably takes place in two ways, either by direct, mechanical rupture of the joint membrane or by erosion of the membrane and a spreading infection along the fascial planes. It is seen most frequently above the supra patellar pouch and may extend above the thigh as high as the great trochanter. It occurs beneath the fascia lata or the quadriceps muscle. Posteriorly it extends up the thigh, beneath the hamstrings, or follows the femoral artery through its opening in the adductor magnus and then up the thigh along Hunter's canal. Posteriorly, it may also extend down the leg beneath the popliteus and gastrocnemius or it may follow the anterior tibial vessels, burrowing down the anterior aspect of the leg between the muscles and the interosseous membrane.

SYMPTOMS.

Rise in temperature, rapid pulse, increased white blood count, distention of the joint, thickening of the membrane, tenderness in the popliteal space, edema about the tibial tubercle, pain about the joint and muscle spasm. Diagnosis is made on the presence of the above symptoms and signs and it ought never to be necessary to aspirate the joint for the purpose of finding the organism.

Symptoms of burrowing. Increase in temperature and pulse, and there is usually swelling over the pus area. There are many cases, however, in which burrowing takes place when no swelling is present and there may be no especial rise in temperature but the pulse remains high. In my experience, pain on deep pressure has always been diagnostic.

SURGICAL TREATMENT.

The surgical treatment of these cases of septic arthritis resolves itself into three distinct groups as follows:

1. Those cases which had been operated early, and later became septic.

2. Those cases which arrived twenty-four to forty-eight hours after being wounded and were unoperated.

3. Operative interference in which there was burrowing and abscess formation secondary to the joint infection.

In the first group, patients usually came directly from the casualty clearing station very soon after operation, and an examination nearly always showed the presence of a moderate reaction, as evidenced by tenderness, swelling, fluid in the joint, some thickening of the membrane and a moderate reaction of temperature and pulse. In a fair proportion of cases this could be attributed to the trauma of operation and transportation. These patients were carefully watched for a day or two and if no infection were present the above symptoms gradually subsided. If, however, these symptoms continued or increased, some of the sutures were removed, allowing the retained pus to escape.

Second Group. Cases unoperated: these cases were carefully x-rayed for the purpose of localizing foreign bodies and diagnosticating fractures. It often happened that this type of case would quiet down under immobilization and operation for the removal of the foreign

body was deferred for ten or twelve days after the temperature had dropped to normal, but if there were indications of beginning sepsis the wounds were excised, foreign bodies removed and devitalized bone thoroughly curetted until there was bleeding. A soft rubber catheter was then inserted and the joint gently irrigated for at least ten minutes by the clock, washing out all fibrin and blood.

The synovial membrane, aponeurosis and skin were sutured in layers, a small rubber tissue drain was inserted down to the capsule to take care of any joint oozing, at the same time draining subcutaneous tissue, in the fat of which infection occurs so easily. This method, which has been employed by Cotton, was successful in a fair percentage of cases and when it was not, it was very easy to treat the joint as in group one.

Group Three. The surgical treatment of burrowing is thorough, through and through drainage in the most dependent portions of the abscess as soon as the diagnosis is made.

DRAINAGE.

It is the opinion of most surgeons having experience in treating joint sepsis that drains in contact with the synovial membrane of a freshly opened joint are not well tolerated. If one observes joint surfaces with which a drain has been in contact, it will be noted that there is an area of hyperemia about the drain and that this area bleeds easily. The frequent removal and renewal of drains, no matter how carefully done, always dilates and tears bleeding tissues, thus opening up new avenues for absorption. On the other hand, when the joint surfaces have become walled off by granulation tissue, they are well tolerated but should not be removed oftener than once in six or seven days.

The type of drains found to be most serviceable was the so-called cigarette drain, and two in the same opening gave better drainage than one. When the infection subsided they were replaced by strips of rubber tissue.

METHOD OF SPLINTING.

There are five prominent factors concerned in continuing and increasing the septic condition of the patient, which are more or less dependent upon the method of splinting and the rigid care employed in immobilization, and are as follows:

1. Pain.
2. Passive manipulation.

3. Irrigation at the time of the dressing.
4. Frequent changing of dressings.
5. Frequent operations performed with the idea of reducing temperature.

Having learned in early orthopædic experience that a flexed arthritic knee was more comfortable than an extended one, and that many patients dated their first night's rest from the institution of the flexed position, it seemed reasonable that septic joints might be more comfortable in a flexed position and, with few exceptions, the knees were placed on bent Thomas splints as follows:

A splint was secured with a well padded and snug-fitting ring, bent at the knee at an angle of about twenty degrees, placed very gently over the leg, pushing the ring snugly against the tubercsity of the ischium. The leg was supported temporarily by means of slings beneath the popliteal space and heel. Traction strips were next applied to the lower leg. When this had been done flannel strips as slings were applied from the ring to just above the heel, the heel strip being removed in order to avoid pressure. Next, the traction was secured to the end of the splint and the leg packed off on each side above and below the aseptic region with cotton; these areas were then snugly bandaged, such bandages being changed at rare intervals. The dressing in the region of the wound was covered by means of a triangle, as it was found that the application of a roller bandage consumed a good deal of time in the aggregate, and, when applied with the greatest amount of care the twisting motion was apt to rotate the splint and result in discomfort a few hours later. The splint was secured to a bed cradle or Balkan frame in such a way as to avoid twisting; the leg was never allowed to rest at any time on the bed, as that was found to be an uncomfortable position. Occasionally, a straight splint was used but we very soon learned that the knee sagged and became hyper-extended, necessitating frequent adjustments of the slings, both of which factors were pain producers. In very sensitive joints, especially in those complicated by fracture, it was usually necessary to obtain more traction than has been described. This was accomplished by raising the foot of the bed and fastening the lower end of the splint to a Balkan frame.

METHOD OF DRESSING.

When a dressing was done the three straps in the region of the knee were loosened and the dressings removed very gently, the wounds were swabbed with some antiseptic, the skin edges carefully cleaned

with ether and alcohol, and a protective dressing of sterile vaseline strips or rubber tissue was applied. A pad, ten by eighteen inches, was placed transversely beneath the leg and covered with loose gauze; the anterior wounds were dressed with gauze and the ends of the pads were gently pulled up between the uprights of the splint and the leg; then the slings were replaced carefully and snugly.

PASSIVE MANIPULATION.

It was soon discovered that any passive manipulation of the joint was always followed by a rise in temperature which lasted three or four days. Therefore everyone was careful in the bed nursing of the patient to avoid any manipulation of the splint or the patient which would result in joint motion.

IRRIGATIONS.

As a surgical principle it would appear that frequent flushing of joint wounds would clear away the debris, diminish absorption and hasten progress. On the contrary, irrigation of joint wounds, even in the late stages, was practically always followed by a general and local reaction, evidenced by a rise in temperature and pulse, onset of pain, and occasionally digestive disturbance in the bad cases. Therefore, postoperative irrigations were given up with only occasionally lapses, which were always followed by the above results. Carrel-Dakin was also given a careful trial but this method did not hasten progress nor prevent tracking of pus; it necessitated frequent changing of dressings, in itself a factor in prolonging the septic condition.

FREQUENT CHANGING OF DRESSINGS.

John Ardine, an English surgeon of the fourteenth century, said, "There is rule in which I have seen err in my time, almost all men not practical but fools; that is to say, of the frequent dressing of wounds. And when such idiots be openly known and not reproved they vex themselves and their patients by their ignorance." It was his custom occasionally to dress wounds daily, but usually he allowed an interval of three days to elapse before renewing his dressings.

When I learned to omit daily dressings I found that the patient's general condition improved more rapidly than in those cases in which daily dressings were done and the temperature and pulse reached a lower level much sooner.

FREQUENT OPERATIONS PERFORMED WITH THE IDEA OF REDUCING TEMPERATURE.

There is no place in surgery where one becomes so concerned as in the presence of a rise in temperature and pulse from a septic knee-joint. Under such conditions radical operations are often performed —such as a U-flapped incision or amputation. It is well to remember, however, before rushing patients to the operating room, that the synovial membrane is one of the most resistive tissues to infection of any in the body and if given half a chance will usually take care of itself.

There is so much ramification of the joint structures, however, which favors the development of focal walled-off abscesses in the several pouches that one must be prepared to secure drainage when necessary. This should be done without removing the patient from the bed or the leg from the splint. A Kelley clamp should be placed in the distended pouch and cut down upon and before removing the clamp a small rubber tissue drain may be drawn through the opening. Frequent operations mean frequent anæsthetizations, which always lower the resistance of the patient; therefore the period of anæsthesia should be as brief as possible and not oftener than absolutely necessary.

SUMMARY.

1. Mobilization will not always replace immobilization, as there are many cases in which mobilization is contraindicated.
2. Careful attention to minor details in adjustment of the splint and bed nursing increases the patient's comfort and resistance.
3. A bent Thomas splint is more comfortable than a straight one and is more easily managed.
4. Slackness and carelessness will always be followed by disaster.
5. Surgical interference should be gentle and precise.
6. Passive manipulation, irrigation at the time of dressing, and frequent changing of dressings all tend to prolong the septic condition.

REFERENCE.

[1] British Surgical Journal, April, 1918.

DISCUSSION OF DR. OBER'S PAPER.

DR. W. G. TURNER, Montreal: *Mr. President and Gentlemen:*—In many of the out of the way places we wander to, we see certain shrines and I think that a shrine should be set up regarding the Thomas splint. Apparatus have been devised, but the only one that has stood the test has been the Thomas

splint. I have been much interested in Dr. Ober's paper on septic knee joint because at one time we were face to face with the task of trying various treatments. It appears to me that the question of the origin of septic knee joint comes under the different headings of penetrating wounds, with or without missile, and septic knee joint of metastatic origin. These can be taken up under two distinct headings regarding treatment. In the service, the treatment that was rapidly evolved, I may say, came under the consideration of various consultants, and the prophylaxis which was secured there was certainly due to our very distinguished friend, who is here today. In 1915, the transportation of these septic knee cases was hurried through to the base, and very often the primary so-called thorough treatment occurred at the bases in France. There, the picture was grave as the septic knee joints were in various stages of joint destruction. What was the result of early prophylaxis in the treatment of these joints? I may say that in the winter of 1916, I saw penetrating wounds of the knee joint treated by means of the Thomas splint as soon as they were brought to the advanced dressing station by the stretcher bearers. They were cleaned up and put into the Thomas splint, and they went out on the Thomas splint. That remained on during the short time before they came into an active surgical zone. X-rays were taken and then the patient was transferred to the operating room of the Casualty Clearing Hospital. The wound was excised, the missile removed and the joint was washed out. Afterwards the joint was closed; except occasionally with a subcutaneous drainage, the Thomas splint was applied with extension. Very often a moulded splint prevented hyper-extension of the knee. Then the patient went on to the base. If there were any collections of pus, the wound could be incised and drained and left open; and if necessary, it could be kept open, sutured to the skin, or a criss-cross incision could be made. That was the method followed with these cases.

Regarding the metastatic cases, where other wounds were present or occasionally without other wounds, it was found wise to aspirate the joint, as a first measure. I had a striking example of that in a soldier who had lost one leg, and who had a stereptococcus infection of the other leg. Suddenly he developed a septic knee with high temperature, etc. We aspirated the knee four times, at intervals. At each operation, the pulse dropped, the temperature dropped, and the leukocytosis dropped. At the end of ten weeks, the knee had recovered complete function. We found that with the most careful watching, and using the Murphy drip and other means of drainage in every case where foreign material was used, it walled off the drainage abscesses collected away from the drain. In every case that came to amputation, such was found to be the case. Conservatism, with the use of the Thomas splint, has opened up a new era in the treatment of the knee joint.

A note of warning here is that when the joint requires to be relieved, incise freely and suture the synovia to the skin. This will allow flushing of the wound. I believe, with Willems, that early moderate movement of the joint should be carried out in most cases by the patient or by the surgeons.

I confess that I have not had any experience of early weight bearing on septic knee joint as advised by Willems.

DR. RALPH R. FITCH, Rochester, New York: *Mr. President, Ladies and Gentlemen:* When immobilization of the knee joint is indicated, I agree with Dr. Ober that the Thomas splint is an excellent medium. He referred almost exclusively to the knee joints as seen in the Service. I shall not say anything about that side of it. As we see infected knee joints at present, I think that the greatest error that we make is to wait. A knee or other joint should be opened on suspicion of infection. I believe that the knee joint will stand more infection than we have ever given it credit for, and come out with good function also. With the local and constitutional signs of infection, I believe we should open it immediately. With the release of tension, a great many of these patients will get along without pain. In such cases, I think it is best not to immobilize, but merely put the leg on a pillow. A great

many will be comfortable, and can move the joint without pain. If there is pain, then I believe that the leg should be immobilized—preferably with the Thomas splint. Why some cases have pain and others have not, I do not know. I think that the drainage should not be put into a knee joint. I believe that when you begin cigarette draining or draining by tubes by putting them into the joint, you almost give up hope of good functional use of that joint. I believe not only that it is better to open these joints and let them drain of their own free will and accord, but that many will be saved if you do it early. Do not wait for forty-eight hours. If the joint is not infected you can do no harm by opening it, but give the joint a chance. When one is morally sure that good functional use will not persist after the infection has quieted down—when one is morally sure—I do not know when that time is: it varies in each case. But when one has reached that point, it is wise to open it with a large horse-shoe incision, take out the semi-lunar cartilage, take out the crucial ligaments, and put the leg on a double inclined plane, which is an old time practice, on wedges, with the sides on hinges, so that the dressing may be done easily. Then, with the Dakin solution in the wound, you can get granulating surfaces; and in a few weeks, you can do a formal resection of the knee joint. You will save the patient a great deal of time, practically obviate the danger of amputation or death, and give the patient a more serviceable leg than he would have had if you had allowed the infection to go on and the leg become stiffened throughout its full length. As the leg is apt to develop fibrous union, the knee is painful whenever the patient stubs his toe. Such reaction is easy, because the hamstring muscles are contracted and hold the bone surfaces face to face, giving a good strong bony union in a short time.

THE REMOVAL OF THE MENISCUS FROM THE KNEE-JOINT.

BY ALBERT H. FREIBERG, M.D., F.A.C.S., CINCINNATI, OHIO.

THE removal of a loose or torn meniscus from the knee is an operation quite frequently called for. It is desirable to have the joint cavity open for as short a period as possible in order that the chance of infection be reduced to a minimum. It is important that the whole of the meniscus be removed in order to avoid disagreeable interferences with function afterward, which are likely to result if a loose stub be allowed to remain. Unless the knee be opened very widely, it is difficult to remove the posterior extremity of the meniscus completely with ordinary knives or scissors; considerable time is usually spent in doing this and no little damage is done to the cartilaginous surface of the femur. In working through the usual short mesial incision with the knee flexed, we have to deal with a cavity of depth whose cross section is smallest where the posterior end of the meniscus must be severed.

It is not possible to help one's self to any considerable degree with retractors.

While working in Walter Reed General Hospital during the war, I designed a knife whose cutting edge was at an angle of 135° with the shank, its end being rounded instead of pointed, so that it was possible to cut with the extreme end of the knife as well as the blade itself. My friend, Dr. W. P. Carr of Washington, D. C., kindly made such a knife for me and it was at once evident upon use that it facilitated the operation greatly. I have used the instrument frequently with great satisfaction, and colleagues who have used it have urged this publication. It is important that the shank and handle should be long. Mine are two inches and five inches, respectively, in the model which I am now using.

MYELOMA OF THE VERTEBRAE.

BY W. G. TURNER, M.D., F.A.C.S., MONTREAL.

MULTIPLE myeloma is a specific malignant tumor of the bone marrow arising, probably, from a single cell type and characterized chiefly by multiple foci of origin, a uniform and specific structure composed of plasma cells or their derivatives, rare metastases, albumosuria, and a fatal termination.

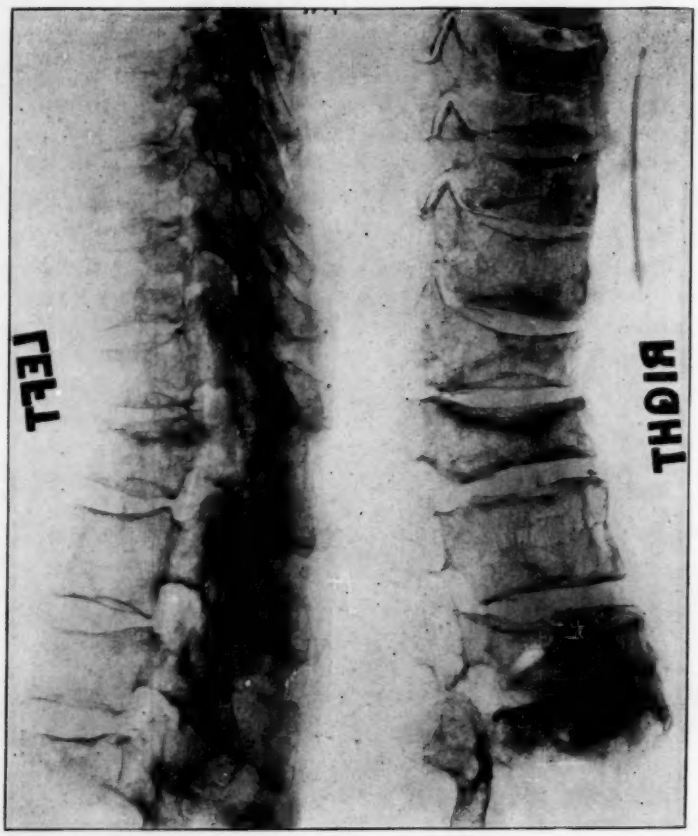
The definition is from Ewing—Neoplastic Diseases. His bibliography ¶ 283-9 is the most complete that I have noted. The early observers discussed the condition under various names. McIntyre, 1850, first described it under the name of "mollities ossium." He noted the presence of Bence-Jones albumose in the urine and many early observers noted the tendency of the disease to limit itself to the bone marrow and the resemblance to an infectious granuloma. Rusticky, 1873, first recognized the disease as a specific affection of the bone marrow and employed the term myeloma.

EXTREME RAREFACTION IN X-RAY.

The ribs and sternum are the chief original seats of the tumors, while the vertebrae, skull, femur, pelvis and humerus are less frequently involved and in the order named.

Last year two cases at the Royal Victoria Hospital have come under my observation, in conjunction with Dr. W. F. Hamilton of the medical service.

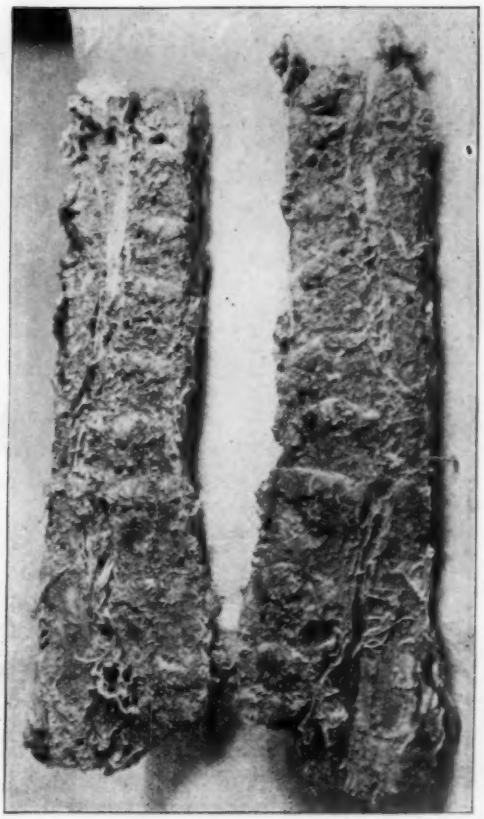
CASE 1. Male, æt. 75,—a vigorous, healthy man, who in the summer of 1919 had arranged for a couple of months' golfing. About the middle of July, 1919, he had a severe fall and fractured his sixth rib, near the angle, right side. Although well strapped, severe pain persisted, with some tenderness. There were no lung or pleura signs. August 20, he was referred to me for severe pain in the back. The pain was very severe, gait very guarded, and he held himself erect with difficulty. The pain was referred chiefly to the lumbar region, third and



X-RAY SPECIMEN. BONY STRUCTURE A MERE SHELL.

fourth vertebrae, also to the dorsal region, sixth, seventh, eighth and ninth vertebrae and to the right about four inches along the sixth, seventh and eighth ribs. No deformity of the column was present. Dorsal decubitus gave some ease, ventral decubitus increased the pain. The tenderness was over the same regions but varied in intensity when tried three or four times. No girdle pain. Reflexes normal; no sensory change. Abdomen and thorax negative. Urine has small amount of albumen: sp. g. 1018. Prostate enlarged but not nodular. Owing to my absence from town I did not see him again until October 18. During that time patient had failed markedly, pain was constant and worse and he was admitted to the hospital.

Pain was much increased about the same segments. The tenderness was about the same as at first examination. Patient was now a bed patient. Vertebral column showed no deformity. No girdle pains, no paralysis, reflexes normal, no sensory change. Abdomen and thorax



PHOTOGRAPH OF SPECIMEN.

negative. There were now irrational intervals with longer lucid intervals. Urine showed definite albumen, no albumose found after repeated examinations. Temperature subnormal. Pulse 84 and regular. X-ray showed only marked bone atrophy. Blood showed 4,000,000 R. B. C., 8,120 W. B. C., 75% hæmoglobin, the other cells in normal percentage ratio. Wassermann negative. Patient failed gradually and died March, 1920, in coma.

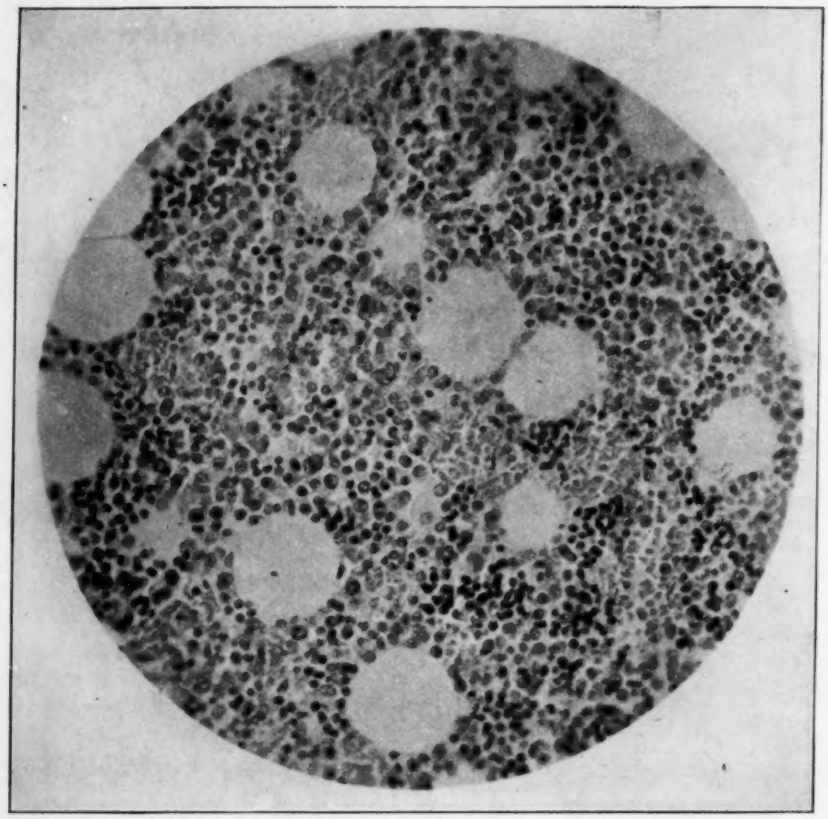
Diagnosis in October—Malignant tumor of vertebrae. Pathologist requested to make special examination of the vertebrae.

Autopsy, Dr. Crowdy, Royal Victoria Hospital.

Male, æt. 75 years. The rest of the body showed only senile change. No metastases found.

The Osseous System.

The clinical history directed attention to the vertebral column. Superficial examination revealed only slight enlargement of the lumbar



MYELOMA. x350.

vertebrae without any deformity, a condition which might be easily overlooked. On removal, however, and longitudinal section an interesting condition was found. Only a peripheral shell—very thin—of bone remained. The vertebrae were replaced by a soft reddish brown (myeloid) tissue, so soft that the finger could penetrate it. The intervertebral discs, however, were relatively intact and these, with the external shell of bone, held the column together. Examination of the ribs showed that a similar but less extensive process envolved them. They were so brittle as to crack easily on the slightest pressure.

Vertebrae.

The sections show a very cellular and vascular tumor. The cells on the whole are of a uniform type but vary in size and shape, many of them are granular, an occasional cell shows eosinophilic granules. The

nuclei are central or excentric, with coarse chromatic granules grouped around the periphery. The cells are divided by large blood channels and sinuses into groups and islands. There is no visible supporting stroma.

Diagnosis: Myelocytoma.

CASE 2. Female, æt. 40. Married; three healthy children.

Admitted September 24, 1920. Had suffered from "tired feeling" in lower back for about one year. February, 1920, had a fall, followed by pretty constant pain between the shoulders. Some lameness and stiff back through the summer. In August, had a febrile attack for ten days. Pain in back increased up to date of admission. Previous health and family history negative.

Pain was the dominant complaint. This was referred to back, "between the shoulders" and to region between eighth dorsal to second lumbar vertebrae. Tenderness moderate over the same region. Patient a bed patient. There is no deformity of the spine. Heart, lungs and abdomen negative. Urine sp. g. 1018, small amount of albumen. No Bence-Jones albumose found in repeated examinations. No nerve signs. Reflexes normal. Wassermann negative. Blood, R. B. C. 4,000,000; W. B. C. 8,000; hæmoglobin 70%. Differential count showed no abnormal percentage of blood cells. Despite treatment, patient failed progressively. Pulse rapid and small, 120. Temperature subnormal.

October 24—"Pins and needles" sensation in legs and girdle pain at level of eighth dorsal vertebra. She also became more nervous and apprehensive. November 16—Paraplegia; double Babinski, and knee jerks, dulled sensation, retention of urine, incontinence of fæces. Irrational at times. The pain is very severe.

The patient failed rapidly and died December 30, 1920, in coma, with marked retraction of the head.

X-ray plates showed extreme bone atrophy. Bone salts appeared absent. Marked narrowing of lumbar vertebrae making the discs appear unusually prominent. No erosion noted.

Autopsy—partial—Dr. Crowdy.

Female, æt. 40 years. Autopsy limited to removal of portion of spine. The portion of spine removed included the sixth dorsal to the third lumbar vertebra. The piece of spine was then sectioned longitudinally. The intervertebral disks are markedly prominent and firm. The vertebrae, however, all show greater or lesser changes. The seventh, eighth, ninth, and tenth are in normal position and approximately normal in shape and size, but are much softer than usual, being easily broken into with a blunt instrument. The eleventh and twelfth vertebrae are distorted in shape. They are much narrower than normal towards the ventral surface, gradually widen out toward the dorsal surface and encroach upon the spinal canal so as to compress the cord and vertebral disk between these two vertebrae. The laminae immediately opposite this point are thin and compressed so that the canal at this

point shows a distinct obtuse angle. The irregular tumor like nodular greyish white masses, which are soft and brain-like in consistence, and the vertebrae themselves encroach on the spinal canal.

Sections taken from the soft white nodular masses seen in the lumbar vertebrae show a very cellular tumor growth replacing the normal cancellous bone and marrow. It is made up of a very uniform type of cell showing a round or oval nucleus with deeply staining chromatic granules with a tendency toward peripheral distribution. The protoplasm is uniformly and lightly staining, the nucleus being placed eccentrically. In some places the tumor is very vascular, showing wide and irregular areas of red blood cells in direct contact with the tumor cells. In other fields only an occasional blood channel is seen and here and there a minute spicule of bone. There is a minimum amount of reticular supporting tissue.

Diagnosis—Myeloma.

Clinical Course. Onset—moderate trauma but no contusion of vertebrae in either case.

Case 1 and Case 2—the dominant symptom was pain.

Pain. The pain was of a "boring" character and very constant. Moderate doses of morphine gave relief in each case for a few hours. At times there were marked exacerbations but in neither case did "spasm pain" appear. The pain was diffuse and in Case 1 would involve several vertebrae, frequently fifth to tenth. Dorsal and frequently first to fourth lumbar. Case 2 showed much the same type of pain, chiefly from third to sixth dorsal and from tenth dorsal to first lumbar. At other times pain was referred to the column from mid dorsal to fourth lumbar. Pain between the scapulae. In this last the pain was usually not so severe as when referred to a definite segment. Pain was more prominent at night. In Case 1 pain was also referred along the fifth, sixth, seventh, and eighth ribs to about four inches from the spine, especially on the left side.

Tenderness. This sign almost corresponded with the pain. Except in the later stages of Case 2 there was no particular localizing to any special one or two vertebrae.

Treatment. Fracture bed, Bradford frame. Radiant heat has no effect on the pain. Special dieting, open air, and general tonic treatment had no noticeable effect on general condition.

Nerve Signs. Case 1 showed no signs of root or cord pressure. Case 2, two months after admission, eight months from onset, had "pins and needles" sensations in legs. Three weeks later definite signs of paraplegia, which in another week involved bladder (retention) and

rectum (involuntary). Hyperæsthetic zone about level of tenth dorsal vertebra. No clonus. Girdle pain about level of eighth dorsal vertebra noted about same time as the formication. The paraplegia was permanent.

Mental Signs. Case 1 became very irrational with moderately long lucid intervals, beginning 3½ months after onset. The last two months very short lucid intervals. Quite tractable and endured pain with courage. Case 2—Extreme desire to recover but very apprehensive of fatal result. Very depressed and nervous at intervals. Six weeks before death memory not accurate and two weeks later was irrational for short intervals.

Heart. In Case 2 the accelerated pulse was definitely noted. No particular irregularity until the later stages. Case 1 twice suddenly fell to ground—collapse was quickly recovered. Case 2—During last three months had frequent "sinking turns," during which the pulse became faster—110 to 120—and weaker. The rapid pulse appears to be an important observation in some cases.

Temperature. In each case was subnormal until the late stages.

Urine. In each case repeated examinations showed a small amount of albumen. No Bence-Jones albumose present in either case. Case 2—As paraplegia became pronounced, developed cystitis. Emaciation progressive.

Blood Picture. No particular anemia. Red blood cells, 4,000,000; hæmoglobin, 70 to 75%. A slight leucocytosis Case 1, 8500; Case 2, 8000. In neither case was there an increase of myelocytes. There was no liver or spleen enlargement, no enlarged nodes in either case. Case 1—Prostate negative. Case 2—Pelvis negative.

X-ray Findings. The extreme atrophy is a marked feature. In Case 2 it was more pronounced, but in each case the rarefaction was extreme. Case 1 showed a nodule on eighth rib. Case 2 appeared to have absence of bone salts. The discs were regular but several of the vertebrae were very much narrowed and flattened. No lipping. Wassermann negative in each case.

Course. Progressive severe pain, progressive emaciation, moderate cachexia, diarrhœa, coma in Case 1 for some days. Case 2—Paraplegia, cystitis, death. Duration— Case 1, death eight months after onset of symptoms; Case 2, death ten months after onset.

ON THE CAUSE OF COXA PLANA.

BY DR. MURK JANSEN, LEIDEN.

In the first publication on "Legg's Disease," or preferably "Coxa Plana," which I read—it may have been 1911—I was struck by a lateroposition of the femoral head in its socket, visible in the illustrations of the described cases. Later publications have contributed to confirm my view that a *congenital lateroposition of the femoral head* associated with due preservation of the acetabular roof and its rim was the primary cause of Legg's disease. In 1918 or 1919, I brought forward this opinion at a meeting in England, and during my the last few months I have collected new facts by going over all my hip cases, old and young, and repeating examination and x-ray photographs in all available cases.

I find the way in which the condition develops is as follows:

The head by its lateral displacement—often visible in the skiagram, especially in not too advanced cases—is made to bear the body-weight on a small lateral portion of its surface only. It is like a billiard ball, which when displaced laterally in a close-fitting cup so that the centres of ball and cup are at some distance from each other, would be in contact with the cup only along a line of its surface. Hence in lateropositio coxae the stresses of body-weight and muscle pull are concentrated on a small lateral portion of the head, whilst its medial part is relieved. (Fig. 1.) This involves excess of stress, first on the lat-

FIG. 1. FIG. 2. FIG. 3. FIG. 4.

eral part of the growth disc, and second, on certain portions of the femoral neck, with relief of the other parts.

1st. It is well known that under certain circumstances* excess of

* Cf. Feebleness of Growth and Congenital Dwarfism. London. Oxford Medical Publications, 1921.

pressure on growth discs will retard growth. Now, in the development of coxa plana the growth disc is seen to draw nearer the horizontal position. (See Fig 2.) A kind of chin (Fig. 2 ch.) forms. The latter may partly be due to the greater length growth of the neck medially, and partly to change of form the neck shows apart from growth, due to

2nd. Excess of stress passing through a portion of the femoral neck. —It is well known† that excessive weight-bearing on bone leads to absorption of lime salts and secondary plasticity. Now the femoral neck may normally be considered to be about the narrowest area through which as much of the body-weight passes. The lumbar vertebrae, for instance, though they have to bear a smaller portion of the body-weight, have a greater transverse section. So relief of part of this area may soon lead to over-exertion for the rest. This may account for the fact that the neck shortens and widens—one of the characteristic features in coxa plana.

It is needless to say that both the horizontal position of the growth disc (head in neck) and the widening of the neck will evolve more readily in cases of feebleness of growth (cf. Feebleness of Growth l.c.). Injurious agents, either before or after birth, which enfeeble the power of growth, enhance the danger of the above deformations.

As the transverse section of the neck increases, the growth disc and head are spread out over a larger area. (See Fig. 3.) The quicker the widening evolves, the more disc and head must tend to bursts and rents and, as regards the disc, to a division into flakes. And it seems plausible that at this stage, jumping end even ordinary walking may bring about the characteristic clefts the skiagram displays. (Fig 4.)

This explanation seems to me in harmony with all the facts I know. For example:

a. That coxa plana, though congenital in its primary cause, develops only after some years of walking: the neck must be widened out before the characteristic flattening and cleaving will occur.

b. That coxa plana is often seen to develop a short time after infectious diseases have been sustained: the injurious agents have temporarily enfeebled the power of growth of the bone and contributed to the plasticity of existing bone.

† Cf. Bone Formation, Its Relation to Tension and Pressure. Manchester University Press, 1920.

c. That it is so closely associated with congenital dislocation of the hip as to sometimes alternate with it or also to follow after hip reduction.

d. That signs of local infection are alien to the process.

It is evident that the laws and rules of bone growth, bone formation and deformation have to be borne in mind for the right understanding of the above considerations. The phenomena of the development of coxa plana are in full accord with these rules, and thus contribute to establish them. For further details of these rules I may refer to the books quoted above.

Correspondence

OPERATIVE TREATMENT OF SCOLIOSIS.

September 13, 1921.

Dr. E. G. Brackett, Editor, *Journal of Orthopædic Surgery,*
166 Newbury St., Boston, Mass.

Sir:

In a paper on the operative treatment of scoliosis printed in the July number of the Journal, I called attention to the advantage of hyperextension of the spine in ambulatory treatment by jackets, and particularly by the convex stretcher frame, both before and after the operation.

In the class of cases under consideration, the capacity of the chest on the convex side, diminished by the rotated spine and increased inclination of the ribs, has been, in many instances, still further lessened by the constriction and pressure incidental to the correction of the lateral distortion. Fixation on the convex frame by contrast increases the expansion of the chest, while the pressure exerted tends to flatten the projecting ribs and to force them forward. Hyperextension also elongates the spine and thus straightens the compensatory curves, and should lessen the resistance of the primary deformity.

The photograph shows the apparatus in actual use in my service at the Hospital for Ruptured and Crippled. It may be noted that in a number of cases weights are attached to the pelvis or limbs and to the head, and in several, there is anterolateral traction on the trunk in addition. Traction is of service in the paralytic deformities of young children, particularly for distortion of the pelvis, but in the class of patients described in the paper, it is doubtful if it is of value except, perhaps, by fixing the patient more securely, to increase the posterior pressure on the projecting ribs.

Very truly yours,

ROYAL WHITMAN.

CARPAL INJURIES.

San Francisco, California, October 28, 1921.

Dr. E. G. Brackett,
Editor, Journal of Orthopædic Surgery,
Boston, Mass.

Dear Doctor:—

During the past two and a half years I have observed in six cases of carpal injuries, a persistent pain beginning at the lower end of the ulna and extend ing along the ulnar side of the wrist and hand and ending about the proximal phalanx of the little finger. The cases in which this has been observed are:

Fracture of the navicular alone—four. (Three of these operated upon, removal of both fragments. The fourth not operated upon.)

Fracture of the semilunar—one. (Two operations, the first removal of the semilunar, the second removal of the navicular.)

One case in which the man had been operated upon four times by as many surgeons who had removed most of the bones of the wrist. The fifth operation, done by myself, was an Ely fixation of the wrist.

All of these patients had pain in the same location, persisting for months, pain worst when the hand was prone upon the table and then supinated, in two cases that lasted over a year and in one over two years. There was an area of hyperaesthesia corresponding fairly closely to the area of pain.

I can find no adequate explanation of this phenomenon based on anatomy. I would greatly appreciate knowing if any of your readers have observed similar cases and also if any of them can offer an explanation as to the mechanism of the pain.

Very sincerely yours,

ARTHUR L. FISHER.

CONCERNING FRACTURES OF THE NECK OF THE FEMUR.

To the Editor,
Journal of Orthopædic Surgery,
Boston, Mass.

Sir:

Dr. Adams' paper in the last issue of the Journal entitled "An Analysis of Seventeen Fractures of the Neck of the Femur" is naturally of particular interest to me. As an analysis, it is rather indefinite. Apparently the patients were of the unfavorable, unrepresentative, hospital class, since in but ten cases was "reduction" attempted. In eight of these the abduction method was employed, but in only four instances under general anaesthesia, nor is it stated that the reduction was verified by x-ray examination.

The result was good both from the anatomical and functional standpoint in seven cases and fair in five others. Although the relation of the method employed to the result obtained is not specified, it may be assumed that the six cases in which reduction was not attempted were not included in the first class. There was one death from pneumonia, but its relation to the treatment is not stated.

I infer from the analysis that Dr. Adams recognizes the technical superiority of the abduction method as a treatment for the fracture, but thinks that the condition of the patient makes it impracticable in about the proportion of cases reported. It may be of interest, therefore, in this connection, to call attention to a similar report of twenty consecutive cases of intracapsular fracture of the femur treated by the abduction method at St. Agnes' Hospital, Philadelphia (*Annals of Surgery*, June, 1921). Eighteen of the patients were from sixty to eighty years of age. In five there was incontinence of urine and fæces, and in six bed sores were present on admission, yet there were but two deaths: one a woman of eighty, semiconscious on admission; the other a sufferer from cardio-renal disease. In nine full function was restored. In eight there was slight impairment of function, and in only five instances was a cane used in locomotion.

The functional results of Dr. Adams' cases may be contrasted with those of Scudder of a similar number of patients treated at the same institution but of a better type, since but three were over sixty years of age,—"yet in

but two instances could the limb be said to be functionally useful." Of sixty cases reported by an earlier writer (Robert Smith), it is stated that thirty died within eight weeks of the injury. He concludes very naturally that "our prognosis in cases of fracture of the neck of the femur must always be unfavorable. In many cases the injury proves fatal, and in all the functions of the limb are forever impaired."

I think that the improved results, both as to function and to mortality, may be ascribed to the efficient treatment of the fracture, and may be accepted as evidence in favor of my contention that in the great majority of cases the abduction treatment which relieves pain and prevents hypostatic congestion and bed sores, is less dangerous than other methods, or even than "life saving" neglect; and that neither advanced age nor the situation of the fracture precludes success, if the opportunity is assured.

I cannot agree, therefore, with Dr. Adams "that there is no class of fractures that requires better judgment as to choice of treatment." On the contrary, it seems to me that there is no class of fractures in which the choice of treatment is so obvious.

The most definite statement in Dr. Adams' paper is, that "the Whitman plasters were suspended in Balkan frames." In my practice the patient is placed on an inclined plane by raising the head of the bed, and is systematically turned at intervals to relieve pressure, and I can see no advantage whatever in suspension.

I call attention to this point because an important feature of the abduction treatment, apart from its mechanical efficiency, is its simplicity and general adaptability. In its application no apparatus is essential, the materials for splinting are always at command, and the treatment from beginning to end is under the control of the surgeon. Thus neither hospital care nor skilled nursing is essential to success.

I note in the discussion that the danger of overabduction is mentioned. This must be very remote in the treatment of recent fractures if one takes the range on the sound side as the model. The real danger is too little abduction either to reduce the deformity or to assure security.

The stiff knee mentioned as a result of prolonged fixation is in my experience of little importance, possibly because the spica in the final adjustment is bent slightly toward flexion at this joint. When it is removed the patient remains in bed until discomfort has subsided, and until fair muscular control has been regained under massage and active and passive movements. As a rule, a free range of motion at this joint is established long before weight-bearing is permitted.

November, 1921. ROYAL WHITMAN.

Note

PROF. DR. SLOMANN, whose paper, "On Coalitio Calcaneo-Navicularis," was published in the November *Journal of Orthopædic Surgery*, has recently written to the *Journal* as follows:

I have had the opportunity lately to make one more observation with reference to the anomaly. Occupied with the study of the os vesalianum tarsi, I found in a paper published by Gelinsky in *Fortschritte der Röntgenstrahlen* (Vol. VIII, 1904-5) the x-ray pictures of a case, in which he has found an os vesalianum in both feet of a young subject, and to this he adds the remark: "*An den Tarsalknochen sind keine Besonderheiten.*" After this it was very interesting for me to observe, that a quite unquestionable (if perhaps not quite typical) coalitio calcaneo-navicularis is clearly present in these pictures in both feet. I think that such a case may perhaps give the key to the singular fact that this anomaly has been hitherto almost or totally ignored in the Röntgen literature.

Current Orthopaedic Literature

FRACTURES OF TRANSVERSE PROCESSES OF THE LUMBAR VERTEBRAE. George G. Davis. *Surg., Gyn., and Obstet.*, September, 1921, p. 272.

Fractures of the transverse processes of the lumbar vertebrae are not infrequent injuries, but have been frequently overlooked. Fractures may be caused by direct or indirect violence, or may be of developmental origin, according to various authorities. The embryology and anatomy is discussed. The writer is of the opinion that practically all cases are due to direct violence. He reports ten cases varying in age from 23 to 54 years of age. He shows roentgenograms and gives short reports of each case. "Backache" is the chief symptom. The pain is well localized, constant, and does not radiate. In some cases the symptoms are mild and the patient may return to work shortly after injury. The condition is often associated with osteoarthritis of the spine.—*F. G. Hodgson, Atlanta, Ga.*

MOBILIZATION OF THE ELBOW BY FREE FASCIA TRANSPLANTATION; WITH REPORT OF THIRTY-ONE CASES. W. Russell MacAusland. *Surg., Gyn., and Obstet.*, September, 1921, p. 223.

The causative factors of ankylosis are discussed. Author considers the elbow the joint most suited for arthroplasties. The history of arthroplasty, the development of the modern technique, and cases reported in the modern literature are gone into quite fully. The operation is contraindicated until epiphyseal growth is complete. Infectious cases should not be operated upon until all signs of the active process have ceased. It is questionable if a tuberculous joint should be operated upon, certainly not until a number of years after it has been healed. Operative technique is carefully described and each step well illustrated. He uses a large, free flap of fascia lata to cover the raw surface of the end of the humerus. The head of the radius is not removed. After closing the wound, the arm is put up in a plaster cast, elbow less than a right angle. Stress is laid upon the after-care. Passive motions are begun in about ten days, gentle massage at three weeks, baking at six weeks. Occasionally, manipulation under anæsthetic is required, and in a few cases, exuberant bone was removed at a secondary operation. The after-treatment was continued for months.

Twenty-eight cases are reported in full. There are a large number of good illustrations and roentgenograms of cases. A bibliography is appended. The article is a noteworthy contribution to the subject of arthroplasty. The results obtained seem to justify the operation of arthroplasty of the elbow, in spite of the fact that some authorities are still in favor of excision.—*F. G. Hodgson, Atlanta, Ga.*

BONE ATROPHY: AN EXPERIMENTAL AND CLINICAL STUDY OF CHANGES IN BONE WHICH RESULT FROM NON-USE. Nathaniel Allison and Barney Brooks. *Surg., Gyn., and Obstet.*, September, 1921, p. 260.

This article should not be abstracted. It is so well worth while that it should be read in its entirety by everyone interested in bone pathology. There are a number of good illustrations and several interesting tables. The purpose of the experimental and clinical study is to determine the effect of non-use of bones as it concerns:

1. x-ray photographs; 2. gross and microscopical anatomy; 3, chemical composition; 4. breaking strength; 5. growth; 6. regeneration.

Dogs were used. Three methods were used to prevent the use of the foreleg: *a.* Section of the brachial plexus—13 experiments; *b.* Excision of the upper end of the humerus—7 experiments; *c.* Plaster of Paris fixation—4 experiments.

Discussion: Regardless of the method used to cause non-use, the changes in the bone were the same. The degree of atrophy of the bone was directly proportional to the degree of non-use. There is no evidence warranting the assumption that any disease process plays any rôle in the production of bone atrophy other than its effect on use. Bone atrophy is not the result of diminished circulation of blood. Bone atrophy is an active process, and the circulation of the blood is necessary to its progress. The process of bone atrophy is not a change in the characteristics of bone as a substance. The process of bone atrophy is a change in the amount of bone present. This affects the size, shape, thickness, length, weight, and texture of the whole bone, and accounts for its changes in gross anatomy, x-ray photographs, breaking strength, and chemical composition. The chemical composition, breaking strength, and regeneration of *bone* remains unchanged. The above conclusions are logically drawn from all the experiments and agree with clinical experience.—*F. G. Hodgson, Atlanta, Ga.*

INTRAPELVIC, EXTRA-PERITONEAL RESECTION OF THE OBTURATOR NERVE. METHOD OF SELIG. L. Kreutz. *Archiv. Orthop. und Undfalls Chir.*, Vol. xix, No. 2, July, 1921.

Lauenstein, in 1893, was the first to report a resection of the obturator nerve for the purpose of eliminating the adductors. Up to the time of Selig's publication, the technique was extra-pelvic, including the methods of Stoffel. Selig, in 1914, proposed to resect the nerve before it passes the foramen obturatum. He recommends the following routes:

1. Abdominal incision at the edge of the rectus muscle,
2. Incision through the rectus, and
3. Incision in the median line.

Working laterally or through the rectus muscle, the transverse fascia, together with the peritoneum, is pushed off, the peritoneum separating easily. As soon as the latter has been separated up to the lower crest of the os pubis, the heavy round strands of the obturator nerve can be felt. The superincumbent vessels must be isolated before the nerve is sectioned.

Of thirteen cases operated upon by the author, all were spastic diplegias; among these, four Little's disease.

In two cases, the resection of the obturator nerve was accomplished from two lateral incisions, in six cases, it was accomplished from one common incision in midline, and in five cases, a supra-spmphyseal transverse section was carried out.

Twenty-four hours before the operation, the abdominal skin and the adjacent parts of the thighs are thoroughly cleansed and before operation the field is covered with iodine and alcohol.

If operating from two lateral incisions, at first incision is made five inches in length on the outer border of the rectus, ending somewhat above the symphysis, the fascia is sectioned and the rectus muscle retracted medially. Then the peritoneum is pushed upward and the median surface of the horizontal ramus of the os pubis is prepared by blunt dissection. The foramen obturatum is ascertained by palpation. The nerve is carefully isolated from the accompanying vessels. Then follows resection of about 3 c.m. of the nerve, suture of the fascia, and closure of the wound.

In operations from a common incision in the linea alba, the incision begins immediately above the symphysis and reaches upward two-thirds the distance to the umbilicus. In the lower third of the incision, the insertion of the pyramidal muscles, and in the upper third, the bladder becomes visible. The latter is retracted upward and one now proceeds to the isolation of the os pubis as in the lateral incision; the nerve is isolated, pulled up by blunt hook and 3 cm. are resected.

Transverse incision: The incision is made three fingers above the symphysis from one anterior superior spine to the other. The incision is curved with concavity pointing toward the umbilicus. Section of sub-cutaneous fat, division of the recti muscles, of the tendons of the obliqui, and of the transversus are done. One then proceeds upon the transverse fascia laterally to the pelvic wall and palpates the foramen obturatum. In doing so, the peritoneum is bluntly separated and retracted upward. The isolation and the resection of the nerve is carried out as in the other incisions. In all cases, a double hip-spica was applied in abduction.

In regard to the muscle function remaining after dissection of this nerve, the author points out that outward rotation is still possible owing to the preservation of the nerve supply of the gemelli, of the obturator internus, etc.

There is also preservation of the power of adduction because the posterior or flexor group of the thigh muscles has an adducting component, as has also the gluteus maximus. The author recommends not to attempt a resection on patients less than two and one-half years of age. In regard to the after-treatment it is emphasized that the abduction hip spica should remain from fourteen to eighteen days. Following the removal of the cast, one should start at once with walking exercises and with active and passive abduction and adduction movements.

The author does not approve of a protracted plaster of Paris fixation.

In two cases in which the double hip-spica was allowed to remain five weeks, an abduction contracture had developed.

Splints are worn to meet the secondary deformities such as knock-knees, or knock-ankles. Flexion contractures of the hip and of the knee will often require additional operative interference.—*A. Steindler, Iowa City, Iowa.*

POSTURE IN RELATION TO MEDICAL AND SURGICAL PROBLEMS. John Allan Talbott. *Virginia Medical Monthly*, September, 1921.

The author calls attention to the vast percentage of physically unfit among the young men of draft age in this country, citing the fact that in the State of Massachusetts, 46 per cent. of the drafted men were refused on account of physical disability. Many of these, however, had disabilities which were remediable, such as backache, weak feet, infected teeth, et cetera. The experience of the recent war demonstrated the fact that many became physically disabled while in the service, and by training, particularly under the observation of orthopaedic surgeons, were benefited and later returned to active service while others were placed at work, which they were able to do, behind the lines. He cites from Lloyd Brown, that of the 746 men at Harvard, 80 per cent. showed postural defects. While the author does not go into the surgical and medical problems relating to poor posture, he has mentioned an important subject and brought to the attention of the profession again the importance of correct posture, especially with those unfortunate individuals who suffer from such conditions as visceroptosis, et cetera, and whose problems are unsolved and little benefited by usual treatment.—*H. W. Meyerding, Rochester, Minnesota.*

A WORK CHAIR. A. M. Emmons and J. E. Goldthwait. *Journal Industrial Hygiene*, September, 1921.

The author has given us a comfortable as well as substantial work chair, and one which it is to be hoped will gradually find its way into the various educational institutions and ultimately into the workshops of this country. The authors give the description together with the measurements and a drawing of the chair, so that it can easily be made. There are a number of illustrations, demonstrating faulty position, such as is frequently seen among stenographers, or those who work long hours at the typewriter or desk.—*H. W. Meyerding, Rochester, Minnesota.*

KYPHOSIS DORSALIS JUVENILIS. H. Scheuermann. *Zt. Orthop. Chir.*, Vol. xli, No. 4, June, 1921.

The author considers in his discussion on dorsal kyphosis the real sagittal deformities of the fixed type in contradistinction to the round-shoulder, which is a postural anomaly which may be corrected actively or passively. His series contains 105 cases; of these, 60 were pure antero-posterior curvatures, whereas 45 were complicated with slight lateral deviations. The lateral deviations appeared as often to the right as to the left and seemed to be accidental complications. It is noteworthy that of his cases 88% concerned boys and only 12% girls, which is almost the converse of the conditions prevailing in lateral curvature. The dorsal kyphosis appears usually in the ages from 15 to 17. It involves young people in the first years after the school period who very often are exposed to considerable physical work. Most commonly it is noted that the curvature develops in the course of six months to a year, and cases are not rare in which two or three months are given as the period of development.

According to the author, this deformity was first described by Schanz, in 1911, who called it the Kyphosis of the Apprentices, indicating an occupational origin. This deformity has nothing in common with traumatic kyphosis or with osteoarthritic conditions. Very scant consideration is given to this deformity in the ordinary text-books and especially there is nothing said about the etiology of the deformity.

The author mentions that H. Virchow described a wearing off of the basal surfaces of the vertebrae in a manner by which the epiphyseal discs become smaller and smaller until they are entirely worn off. This condition he claims to have found in some tribes of the Australian negroes who maintain a stooping attitude. The author believes that in the deformity found under his observation, similar attitudinal or occupational elements may have come into play and he has investigated the x-ray findings with a view of obtaining light in regard to the pathogenesis of this deformity. In later childhood, the body of the vertebra produces epiphyses which finally give the body its definite form. These epiphyses are not solid discs but have the shape of rings which are broadest at the anterior border of the body, and smallest at the posterior. Before the formation of these epiphyseal rings, the basal surfaces of the vertebrae are convex and the vertebral discs accordingly concave. After the appearance of the epiphyseal rings, the basal surfaces of the vertebrae are concave and the epiphyseal discs, accordingly, convex. The fusion of the discs with the bodies occurs between 22 and 24 years of age. Evidences of epiphyseal rings are observed as early as at 11 years. The calcification begins at the anterior border of the vertebrae and proceeds gradually backward. If one studies the x-ray picture of a typical dorsal kyphosis in the side view, one notices in the more acute period or within the first half-year, that the vertebral bodies which correspond to the most concave portion of the curve appear considerably lower in front than behind. The vertebral bodies distinctly assume a wedge shape. At the anterior border, one notices the epiphyseal discs not as a small triangular portion as usual but as a broad and irregular contoured mass. The question is: Which of the two facts is to be considered primary—the wedge-shaped formation of the vertebrae with following kyphosis, or the kyphotic curvature of the vertebra due to muscular insu ciency with following secondary wedge-formation? According to the author's opinion, there is no doubt that the trouble starts in the growth of cartilages of the epiphysis, and for this reason the author protests against the name of kyphosis muscularis. He draws a parallel between this condition and the osteochondritis deformans juvenilis of the hip to the extent that he proposes for this deformity the name of osteochondritis deformans juvenilis dorsi.

There exists no effective treatment of this deformity. Several attempts made by the author to correct the deformity by plaster casts applied in lordotic position of the body failed. As soon as fixation is accomplished, it is impossible to re-establish normal conditions, but during the earlier periods when the patient complains of pain in the back, it is possible to give relief by extension followed by plaster of Paris fixation.—*A. Steindler, Iowa City, Iowa.*

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